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PHYSICAL OBSERVATIONS

OF

JUPITER

MADE AT THE

ADELAIDE OBSERVATORY

By the Late EDWARD PERRONET SELLS and by W. ERNEST COOKE, M.A.,
during the Years 1884-1893,

UNDER THE DIRECTION OF

The Late SIR CHARLES TODD, K.C.M.G., M.A., F.R.S., F.R.A.S., F.R.M.S.,
M.I.E.E., Government Astronomer.

Appendix I.—Observations of the Jovian Satellite Phenomena, 1876 to 1905.
Appendix II.—Tabular Errors of Predictions of Eclipses of Jupiter's Satellites.
Plates 1-22.—Drawings of Jupiter, 1884 to 1893.

Edited by G. F. Dodwell, B.A., F.R.A.S., Government Astronomer; and Published by Authority of the Honorable the Minister of Education.

Adelaide:
Printed by R. E. E. Rogers, Government Printer, North Terrace.
1913.

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EXPLANATORY NOTE.

A brief abstract of the accompanying observations and drawings of Jupiter was communicated to the Royal Astronomical Society, and printed in Monthly Notices, vol. 57, page 152, *et seq.* I believe that the late Sir Charles Todd wished to publish the whole of this work, but unfortunately funds were not available at the time. It would be a matter for regret, however, if the work of so skilful an observer and draughtsman as the late Mr. E. P. Sells, and of his collaborator, Mr. W. E. Cooke, who was then Chief Assistant at this Observatory, were not to be included amongst the permanent records of the telescopic appearance of Jupiter, and I am glad that we now have an opportunity of publishing it

In regard to the Appendices it is thought that it may be useful to collect and publish here the numerous observations of the Jovian Satellite Phenomena which are scattered through various appendices of the meteorological publications of the Adelaide Observatory from the year 1876 onwards, or which until now have remained unpublished.

G. F. DODWELL,
Government Astronomer.

Adelaide Observatory, September 1st, 1913.

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INTRODUCTION.

INSTRUMENT AND OBSERVERS.

The instrument used in making the following observations was an equatorial refractor of 8in. aperture and 9ft. 11in. focal length, constructed by Cooke and Son, of York. Until 1891 the eyepiece most frequently used was one giving a magnification of 200 diameters, but from that year onwards a micrometer eyepiece, power 163, was often employed and was found to give rather better results. For the observation of white spots a power of 125 seemed the best, the spots standing out in relief with that power as they did with no other. This may partly have been due to the greater contrast arising from the use of the low power, and partly due also to the eye, when higher powers are used, being attracted more to the forms of the dark markings, and the white spots are consequently not so easily noticed. In the accompanying observations there are comparatively few records of white spots.

The observers, up to 1887, were Mr. W. E. Cooke, M.A., first assistant, and Mr. E. P. Sells, third assistant, and after that date Mr. Sells only.

MODE OF OBSERVATION.

The mode of observation was as follows :—A careful scrutiny of the planet was first made, the forms of the different markings being carefully noted. The chief belts were then drawn lightly in pencil across the disc, on prepared blank forms, in about their proper latitudes, as near as could be judged by the eye, and then some conspicuous marking, preferably near the central meridian, was put down in position, and the hour and minute immediately noted. Then, as quickly as possible, the rest of the sketch was filled in, great attention being paid to giving the markings their true shapes. Then, or shortly afterwards, detailed remarks were usually written, such being necessary to corroborate and describe any feature that might require investigation afterwards. Next day the pencil drawings were carefully copied in monochrome, burnt sienna being used for the belts and other markings. This was found to give by far the best result, though entailing more work than a pencil sketch, the brush and color giving a truer representation of the planet and allowing of differences of light and shade being shown more correctly. In order to ensure accuracy the belts and markings were transferred on tracing-paper from the original sketch to the blank form on which the finished drawing was to be made. For drawings of Jupiter to be of any use a certain amount of diagrammatic representation is an absolute necessity, and definite outlines have been given to the markings wherever possible.

In 1891 and 1892-93 micrometer measures of the latitudes of the belts were made occasionally, but owing to the erratic going of the driving clock and the bad definition met with in those years the measures are not so reliable as they might otherwise have been. The latitude answering to any measure was taken out by inspection from the following table, prepared from the formula—

$$\log.\ \cot.\ \phi = \tfrac{1}{2}\log.\ (1 - y^2) + \log.\ \frac{a}{b} + \text{A.C.}\ \log.\ y,$$

where ϕ = latitude angle and y = perpendicular distance of the marking from the equator, expressed in terms of the polar radius, the compression being taken as $\frac{1}{16}$.

y	Latitude.	y	Latitude.	y	Latitude.	y	Latitude.
	°		°		°		°
·01	0·54	·21	11·39	·41	22·85	·61	35·82
·02	1·07	·22	11·94	·42	23·46	·62	36·53
·03	1·61	·23	12·49	·43	24·06	·63	37·25
·04	2·15	·24	13·05	·44	24·67	·64	37·99
·05	2·69	·25	13·61	·45	25·29	·65	38·73
·06	3·23	·26	14·17	·46	25·91	·66	39·47
·07	3·76	·27	14·73	·47	26·53	·67	40·23
·08	4·30	·28	15·29	·48	27·16	·68	41·01
·09	4·84	·29	15·86	·49	27·79	·69	41·79
10	5·38	·30	16·43	·50	28·42	·70	42·58
11	5·92	·31	17·00	·51	29·07	·71	43·39
·12	6·46	·32	17·57	·52	29·71	·72	44·21
·13	7·01	·33	18·15	·53	30·37	·73	45·04
·14	7·55	·34	18·72	·54	31·03	·74	45·89
·15	8·09	·35	19·30	·55	31·69	·75	46·75
·16	8·64	·36	19·89	·56	32·36	·76	47·63
·17	9·19	·37	20·47	·57	33·04	·77	48·53
·18	9·73	·38	21·06	·58	33·72	·78	49·44
·19	10·28	·39	21·66	·59	34·41	·79	50·38
·20	10·83	·40	22·25	·60	35·11	·80	51·34

On many occasions three or more drawings were made the same evening, usually at intervals of 50 minutes, answering to a rotation of the planet through about 30°. It was hoped that when the planet was in south declination a set of observations might be taken extending completely round the planet on one night, so as to show the whole of its surface during one rotation. This has only once been accomplished, on June 24th, 1889, when the two end drawings did overlap each other a little. Generally cloud has interfered, or else a south-easterly breeze springing up has destroyed the definition and so put an end to observation.

In taking out the zenographical longitudes answering to different times, Mr. Marth's System II. has been used throughout, with the corrections which he gives in the R.A.S. Monthly Notices for May, 1892, vol. 52, page 536.

All times are given in Greenwich mean time, and the drawings have been inverted so as to agree as to their cardinal points with drawings made in the Northern Hemisphere.

For publication the drawings have been plotted on a plane orthographical projection, each night of observation having a planisphere to itself. This allows the proper motions and changes in form of the markings to be easily followed, there being six planispheres on a sheet. The latitude parallels have been omitted for greater clearness and because they would not be of much use in any case.

ATMOSPHERIC CONDITIONS AT ADELAIDE.

The atmosphere at Adelaide is not, on the whole, very favorable for planetary observation. In 1885 and 1886 the definition on a great many nights was noted as " very good " or " splendid," but since those years nights of good definition have been much scarcer, and in 1891, 1892, and 1893 were very few in number. There is no lack of clear nights, but quite as great an enemy as cloud, for planetary work, is found in the south-east wind, which, unfortunately is common at night in all months of the year, but more especially in summer, and which completely destroys definition. On some occasions, Jupiter has been seen without a trace of any markings upon it, even the equatorial belts being completely blotted out, solely on account of the bad definition due to a south-easterly wind. When the wind veers to N.E. and N., on the approach of a barometric depression, the definition usually becomes fairly good, and sometimes very good, and when it blows from any point between N. and S.W. first-class definition can usually be reckoned upon.

Sometimes the night before a very hot day, one, that is, on which the temperature in the shade will be 100° or more, is extremely favorable for planetary work, though on such occasions there often seems to be a want of *brilliancy* in the seeing, which is not so important, however, as the steadiness of the image. Unless the atmosphere allows of good seeing it is mere waste of time making planetary sketches, as the true forms of the markings cannot be distinguished and all delicate detail vanishes.

List of drawings of Jupiter from which the charts have been prepared—

G.M.T. of Drawing.				Longitude of Central Meridian.	Power used.	Observer.	Remarks.
1884							
	d.	h.	m.	°			
Feb.	25	22	54	137·9	200	S	Definition very good at times
Mar.	10	22	43	74·7	200	S	Definition good
“	16	21	55	226·9	200	S	Definition very good
“	19	21	25	299·5	200	S	Definition splendid
“	20	21	24	88·9	200	S	“ “
“	20	22	56	144·5	200	S	“ “
“	30	21	55	169·1	200	S	Definition very good
“	31	21	42	311·8	200	S	Definition rather unsteady ; good at times
April	6	21	36	128·9	200	S	Definition rather unsteady ; very good at times
“	14	21	31	246·9	200	S	Definition good, but unsteady at times
“	19	21	5	261·7	200	S	“ “
“	20	20	37	34·9	200	S	Definition splendid
May	4	20	17	323·9	200	S	“ “
1885							
Feb.	16	0	55	32·0	200	S	Definition not very good
“	19	0	31	108·7	200	C	Definition splendid
“	22	0	28	198·0	200	S	Definition good
“	25	0	46	300·1	238	C	Definition splendid
Mar.	4	1	16	290·9	200	C	“ “
“	4	3	46	21·6	200	C	Definition excellent
“	5	2	16	117·6	200	C	Definition magnificent
“	5	4	46	208·2	200	C	“ “
“	8	3	1	235·8	200	C	Definition splendid
“	9	0	9	282·2	200	S	“ “
“	9	23	26	46·6	200	S	Definition good at times, but very variable
“	10	1	41	128·2	200	S	Definition good at times, but variable
“	15	2	4	173·9	200	S	Definition pretty good
“	15	4	28	260·9	200	S	“ “
“	17	0	6	43·2	200	S	Definition good
“	18	2	3	264·2	200	S	Definition fair, good at times
“	22	22	41	173·7	200	S	Definition very good
“	22	23	31	204·0	200	S	Definition not very good
“	23	0	21	234·2	200	S	“ “
“	23	1	11	264·4	200	S	Definition not good
“	23	2	1	294·6	200	S	Definition very good at times

List of drawings of Jupiter—continued.

G.M.T. of Drawing.				Longitude of Central Meridian.	Power used.	Observer.	Remarks.
1885							
	d.	h.	m.	°			
Mar.	23	2	51	324·8	200	S	
“	27	0	18	113·6	200	S	Definition very good
April	1	2	40	230·8	200	S	Definition good
“	7	0	46	343·5	300	C	Definition splendid
“	8	0	26	121·7	200	C	Definition good
“	8	22	46	211·5	300	C	Definition splendid
“	9	1	58	327·5	200	C	Definition very good
“	9	23	16	19·8	200	C	Definition splendid
“	10	0	46	74·2	200	C	Definition very good
“	27	0	16	89·6	200	C	“ “
“	27	22	6	161·3	300	C	Definition very good at times
“	28	22	56	341·6	200	S	Definition unsteady, but splendid at times
“	29	22	36	119·7	300	C	Definition splendid
June	10	21	16	256·0	300	C	Definition good, very good at times
Dec.	1	6	1	257·0	200	C	Definition very good
“	10	6	16	178·2	200	C	Definition very good, but little detail visible
“	13	5	46	250·7	200	C	Definition splendid, but cirrus cloud about
“	14	6	46	77·2	200	C	Definition splendid
1886							
Jan.	12	5	36	73·1	200	C	Definition very good
“	14	4	36	337·5	200	C	“ “
“	22	4	6	82·0	200	C	“ “
“	25	6	11	248·6	200	C	Definition splendid
Feb.	3	2	25	25·3	200	S	Definition very good
“	3	3	52	77·9	200	S	Definition not so good as at 2h. 25m.
“	3	5	16	128·6	200	S	Definition generally good
“	4	3	38	219·7	200	S	“ “
“	5	4	6	27·0	200	S	Definition good, but variable
“	6	4	10	179·8	200	S	Definition very good
“	6	6	13	254·1	200	S	“ “
“	7	4	11	330·8	200	S	Definition unsteady, but very good at times
“	7	5	21	13·1	200	S	Definition good, but thin cloud over planet
“	8	3	5	81·3	200	S	Definition very good
“	8	4	37	136·9	200	S	“ “
“	8	6	35	208·2	200	S	Definition generally good
“	9	2	36	214·1	200	C	Definition very good at times, but variable
“	9	4	36	286·6	300	C	Definition very good
“	9	6	46	5·2	300	C	“ “
“	18	3	41	167·0	200	S	“ “
“	21	4	4	272·0	200	S	“ “
“	22	3	56	57·6	200	S	“ “
Mar.	10	5	16	352·5	200	C	Definition generally very good
“	15	5	6	18·4	200	C	Definition good
“	18	4	46	97·5	200	C	Definition very good
“	23	4	1	102·3	200	C	Definition generally very good
“	26	4	1	193·5	200	C	Definition magnificent
“	28	2	6	64·7	200	C	Definition very good
April	3	4	26	331·7	200	S	Definition generally good, but variable
“	5	2	23	198·0	200	S	Definition very good
“	5	3	42	245·8	200	S	Definition generally good, but variable
“	5	23	26	241·5	200	S	Definition fairly good, but variable
“	6	0	16	271·7	200	S	Definition fairly good, but very variable
“	7	0	36	74·1	200	S	Definition very good
“	7	3	6	164·7	200	S	Definition good ; through cloud
“	9	1	56	63·2	200	S	Definition good at times, but very variable
“	11	2	35	27·4	200	S	Definition very good
“	11	4	6	82·4	200	S	Definition generally very good
“	17	0	21	128·4	200	S	Definition variable, but very good at times
“	18	23	6	23·8	200	S	Definition very good, but becoming variable

List of drawings of Jupiter—continued.

G.M.T. of Drawing.				Longitude of Central Meridian.	Power used.	Observer.	Remarks.
1886							
	d.	h.	m.	°			
April	18	23	56	54·0	200	S	Definition generally good
“	20	3	18	326·4	200	S	Definition very good
“	26	21	56	103·8	200	S	Definition generally very good
“	26	22	46	134·0	200	S	Definition generally good
“	26	23	35	163·7	200	S	Definition very variable
“	27	0	25	193·9	200	S	Definition generally bad ; good glimpses at times
May	2	23	19	335·7	200	S	Definition generally very good
“	13	21	59	140·0	200	S	“ “ “
“	28	23	9	275·3	200	S	Definition good at times, but variable
1887							
April	24	1	36	242·2	200	C	Definition very good
May	16	1	26	304·2	200	S	Definition good
July	11	22	1	276·7	200	S	“ “
1888							
May	17	0	1	288·7	200	S	Definition good
June	15	0	56	2·8	200	S	Definition variable ; very good glimpses at times
July	31	0	21	53·1	200	S	Definition good
Aug.	3	22	54	241·2	200	S	Definition generally good
“	6	20	41	251·3	200	S	Definition good
“	7	20	41	41·5	200	S	Definition very good
“	7	23	31	144·2	200	S	Definition very variable ; good at times
1889							
May	14	2	23	16·3	200	S	Definition variable, but generally good
“	15	1	56	150·4	200	S	“ “ “
“	15	2	46	180·6	200	S	Definition good
“	15	3	36	210·8	200	S	Definition generally good
“	15	4	26	241·0	200	S	Definition good
“	15	5	16	271·3	200	S	Definition getting bad
“	16	1	56	300·8	200	S	Definition variable, fair at times
“	16	2	46	331·0	200	S	Definition good
“	16	3	36	1·2	200	S	Definition variable, generally good
“	16	4	26	31·4	200	S	Definition generally good
June	23	22	46	291·5	200	S	Definition generally good, but variable
“	23	23	36	321·7	200	S	“ “ “
“	24	0	26	352·0	200	S	Definition good
“	24	2	6	52·4	200	S	“ “
“	24	2	56	82·6	200	S	Definition mostly bad ; pretty fair at moments
“	24	3	46	112·8	200	S	Definition fair
“	24	4	32	140·6	200	S	Definition good
“	24	5	22	170·9	200	S	Definition bad, and planet boiling
“	24	6	12	201·1	200	S	Definition good, but clouds continually coming over
“	24	23	34	110·9	200	S	Definition good
“	25	0	24	141·2	200	S	Definition variable, but generally good
“	25	22	44	231·1	200	S	Definition good
“	25	23	34	261·4	200	S	Definition variable ; good glimpses at times
July	2	22	39	200·8	200	S	Definition variable ; very good at times
“	2	23	34	234·1	200	S	
“	3	0	26	265·5	200	S	Definition very variable ; fair at times
“	3	1	9	291·5	200	S	
“	3	2	1	322·9	200	S	Definition variable ; very good at times
“	3	2	51	353·2	200	S	Definition very variable ; mostly bad ; fair at times
“	3	3	41	23·4	200	S	Definition very variable ; mostly very bad ; good at times
“	10	0	56	256·2	200	S	Definition variable ; good at times
“	10	2	11	301·5	200	S	“ “ “
“	15	23	50	38·5	200	S	Definition very variable ; good at times
“	17	21	46	264·2	200	S	Definition good
“	17	22	36	294·4	200	S	Definition variable, but good at times
“	17	23	28	325·8	200	S	Definition variable, but generally good

List of drawings of Jupiter—continued.

G.M.T. of Drawing.				Longitude of Central Meridian.	Power used.	Observer.	Remarks.
1889							
	d.	h.	m.	°			
July	18	0	31	3·9	200	S	Definition not good
"	18	1	6	25·0	200	S	" "
"	18	22	20	75·1	200	S	Definition variable ; good at times
"	31	21	55	214·0	200	S	Definition very good
Aug.	21	0	41	79·2	200	S	Definition good
Sept.	1	22	51	15·0	200	S	Definition good, but detail faint
"	2	0	50	86·9	200	S	Definition variable, but generally good
1891							
Aug.	5	0	41	16·9	200	S	Definition fair, but image unsteady
"	5	1	41	53·2	200	S	Definition good
"	5	2	23	78·6	200	S	Definition very good
"	5	3	18	111·8	163	S	Definition good, but rather variable
"	5	4	11	143·8	163	S	Definition fair
"	5	5	10	179·5	163	S	Definition not good
"	24	1	15	15·1	163	S	Definition good, but clouds prevented completion of sketch
"	28	0	40	235·6	163	S	Definition good
"	28	1	55	280·9	163	S	Definition variable ; good at times
"	28	3	9	325·6	163	S	Definition fair
Sept.	5	0	35	355·9	163	S	Definition fairly good
"	9	23	3	332·2	163	S	Definition good
"	9	23	51	1·2	163	S	Definition good, but clouds passing over continually
"	10	0	50	36·8	163	S	Definition good
"	10	1	40	67·1	163	S	Definition good, but variable at times
"	10	2	46	107·0	163	S	Definition good, but variable
"	10	3	41	140·2	163	S	Definition fairly good
"	10	4	46	179·5	163	S	Definition good
"	10	5	38	210·9	163	S	Definition fair
"	15	22	23	130·3	163	S	Definition variable ; good at times
"	15	23	29	170·2	163	S	Definition not good, and very variable
"	16	0	18	199·8	163	S	Definition very variable and not good
"	18	1	28	182·9	163	S	Definition good, but clouds prevented completion of sketch
"	19	21	40	345·8	163	S	Definition variable ; fair glimpses at times
"	19	22	51	28·7	163	S	Definition fair, but clouds passing over
"	20	0	16	80·1	163	S	Definition good
"	21	0	41	245·5	163	S	Definition good, but clouds prevented completion of sketch
"	25	22	30	198·2	163	S	Definition very variable and not good
"	27	21	15	93·5	163	S	Definition rather variable, but generally good
"	27	22	9	126·1	163	S	Definition very variable ; fair glimpses at times
"	27	23	19	168·4	163	S	Definition bad ; fair glimpses at times
"	29	21	8	29·9	163	S	Definition very good
"	29	22	7	65·6	163	S	Definition generally good, but becoming unsteady
"	30	0	56	167·7	163	S	Definition variable, good at times
Oct.	7	21	44	174·2	163	S	Definition generally good, but variable
"	7	22	34	204·4	163	S	" " "
"	7	23	29	237·7	163	S	" " "
"	8	0	19	267·9	163	S	Definition good
"	8	1	25	307·8	163	S	" "
"	8	2	16	338·6	163	S	Definition very good
"	9	23	14	169·2	163	S	" "
"	14	21	31	138·3	163	S	Definition good, but variable at times
"	14	22	42	181·2	163	S	Definition variable ; good glimpses occasionally
"	17	22	10	252·7	163	S	Definition variable, but generally good
"	17	23	25	298·0	163	S	Definition variable, good at times
"	18	1	4	357·9	163	S	Definition variable ; fairly good at times
Dec.	1	22	54	196·9	163	S	Definition variable, and not good

List of Drawings of Jupiter—continued.

G.M.T. of Drawing.	Longitude of Central Meridian.	Power used.	Observer.	Remarks.
1892	°			
d. h. m.				
Dec. 4 23 4	179·8	163	S	Definition variable ; fair at times
“ 5 0 1	214·3	163	S	“ “ “
“ 15 22 27	6·9	200	S	Definition good at times
“ 18 22 56	117·5	163	S	Definition fair ; good at times
“ 19 1 13	200·3	163	S	Definition variable ; good at times
“ 20 22 45	51·2	163	S	Definition variable ; very good at moments
“ 20 23 40	84·4	163	S	Definition variable ; fair glimpses at times
1893				
Jan. 8 22 26	11·9	163	S	Definition fair, but variable
Oct. 24 2 6	184·6	163	S	Definition very variable
“ 24 3 12	224·5	163	S	“ “
“ 24 4 5	256·5	163	S	Definition improving, but still variable
“ 24 5 8	294·6	163	S	Definition bad ; occasional fair glimpses
Dec. 8 22 31	132·5	200	S	Definition fair, but variable
“ 8 23 32	169·4	200	S	Definition fairly good, but variable
“ 10 23 19	102·2	200	S	Definition very variable
“ 11 0 36	148·8	200	S	Definition very variable, and not at all good

REMARKS, 1884.

Not very much detail was seen on the planet in 1884, but this may partly have been due to the observers not having had much experience with Jupiter. so that their eyes were unused to the work. The sketches taken in the early part of the year show scarcely any detail beyond a few white spots on the Bright Equatorial Zone, and only a few of the drawings made have been reproduced for publication.

The North Polar Cap was fairly distinct.

The North Temperate Belt was straight and narrow on all occasions, and both to north and south of it on some nights a faint fine line of shading was seen.

The North Equatorial Belt was generally seen broken up into disconnected short belts, having very diffused edges, though on some occasions it appeared as a continuous belt across the whole of the visible disc.

On April 20th, at 20h. 37m. (*c.m.* = 34°·9), one of the short pieces into which the belt appeared to be cut up had a small black spot at its *preceding* end, the longitude of which, taken from the drawing, would be about 357°. This black spot was noticed before, on March 25th, but no drawing was then taken. On May 5th the spot was seen again, and by this time it had altered its position to approximate longitude 316°, and the short belt on which it was placed had joined with the longer belt *following* it.

The Bright Equatorial Zone was very free from markings during this apparition. A few white spots were seen touching the northern edge of the South Equatorial Belt, as in the following list, the approximate longitudes being taken from the drawings:—February 20th, longitude 44°; February 26th, longitudes 126°, 169°, 179°; March 10th, longitudes 62°, 71°; March 13th, longitude 96°; March 16th, longitude 198°; March 19th, longitude 303°; April 6th, longitudes 130°, 150°; April 7th, longitude 5°.

To Mr. Cooke this zone usually had the appearance of being covered with cumulus or cirro-cumulous clouds, while later on in the opposition the appearance, as noted by Mr. Sells, was that of arches of faint shading superposed on a bright background. The interior of the arches was usually brighter than that part of the zone outside, or to the north, and with a low magnifying power and on nights of bad definition this gave an appearance of bright spots ranged along the southern portion of the zone.

THE SOUTH EQUATORIAL BELT was by far the broadest dark belt on the planet, and the familiar Great Hollow or Bay in it, to the north of the Great Red Spot, was very sharply defined.

On many occasions white streaks were observed on this belt, sometimes greatly inclined to its longer axis. On March 13th, for instance, at 2h. 3m., a white streak was seen almost cutting the belt across; it started from the northern edge, where a white spot rested on it, in about longitude 96°, and was inclined about 40° to the latitude parallel. The streak was seen again on March 13th, at 21h. 56m., and then appeared to cut the horizontal line at even a greater angle.

Again, on March 20th, at 21h. 24m., a narrow white streak was seen to start from the northern edge of the belt in approximate longitude 59°, almost over the *following* shoulder of the Great Hollow, extending in a slanting direction eastward to about longitude 124°. This was seen again on April 7th at the *preceding* limb of the planet.

The most remarkable feature in connection with this belt in 1884 was a change of color noted at one part of it on April 20th, at 20h. 37m. The Great Hollow, north of the Great Red Spot, was nearly central on the disc, and the belt on each side of the Hollow was divided lengthways by a narrow light streak, the streak on the *preceding* side of the Hollow running parallel to the Equator, while the other was slightly inclined southwards. The angular shoulder *following* the Hollow was fairly sharp and well-defined, but that on the *preceding* side was especially so, and moreover the southern component of the belt on the *preceding* side was a deep *blood-red* color, fading off gradually towards the planet's limb. The color was most pronounced.

On May 4th, at 20h. 17m., the white streak *preceding* the Great Hollow was found to join with the Bright Equatorial Zone in approximate longitudes 308° and 348°, each of the two short belts thus formed [see chart] having a small dark spot at its *preceding* end, the first of these spots being especially dark and conspicuous.

As a rule the southern edge of the belt was darker and more sharply defined than the northern edge.

THE GREAT RED SPOT was only seen on three occasions, March 10th, at 22h. 43m.; March 13th, at 0h. 23m.; and April 20th, at 20h. 37m. On the first two occasions it was very faint and no definite outline could be discerned. On the 20th April a form was given to it on the drawing which may perhaps have represented the most conspicuous part of the Spot. Probably the remainder of it was too faint to be seen in the strong twilight, the drawing being made about a quarter of an hour after sunset.

THE SOUTH TEMPERATE AND POLAR REGIONS showed but little detail, and that generally faint and indistinct. The most noteworthy feature was the appearance of a small round dusky spot in about latitude 30° S., in the line of a rather faint belt, which came to an end on each side of the spot, leaving a white space between the spot and the ends of the belt. To the south was a narrow white band separating the faint belt from the equally faint Polar Shading, the northern edge of the latter dipping slightly southwards immediately south of the spot and acquiring there a deeper shade. It almost looked as if the small spot had the same repulsive action as the Great Red Spot. The spot was seen at mid-transit on March 20th, at 22h. 56m. (central meridian 144°·5), and on April 6th at 21h. 36m. (central meridian 128°·9); [see also the Remarks for 1886 and 1889].

REMARKS, 1885.

This year a much greater amount of detail was seen, as an inspection of the charts will show.

North Polar and Temperate Regions.—The North Polar Cap was fairly plain during the greater part of the apparition, but on March 22nd, at 22h. 41m., it was noted that "the North Polar markings are very faint and ill-defined indeed," and on April 8th, at 0h. 26m., it was remarked "The planet to-night looks rather curious, for while the various markings near the Equator are quite distinct and the limb is well-defined, no detail is visible north or south of the two dark belts" (meaning the north and south Equatorial Belts), and again the next evening, April 8th, at 22h. 46m., "Hardly any coloring can be seen near the North Pole." On this last occasion, however, at a later hour (April 9th, 1h. 58m.), the North Polar Shading was noted as being much darker than usual, so that it was over part only of the planet's disc—say between longitudes 60° and 250°—that is was so faint.

On April 7th, at 0h. 46m., a narrow dark belt formed an edging to the North Polar Cap, and on April 29th, at 22h. 36m., two narrow dark belts, extending over some 60° of longitude, were seen immersed in the Polar Shading, one at its southern edge and the other further north.

There were usually two North Temperate Belts, situated more or less closely together and on some occasions even effecting a junction with each other. Thus on March 5th, at 4h. 46m., these two belts were noted to have contracted in width and joined together near the central meridian, though still remaining double on either side. The same appearance was noted on March 8th, at 3h. 1m., when the junction was again centrally placed, but on this night the single belt formed out of the two had a darker shade than either of its components, and the North Polar Cap also had a darker shade immediately to north of the other [see chart]. Also compare the drawing made March 18th, at 2h. 3m., showing the shading on both the North Temperate Belt and the North Polar Cap. The junction of the two belts at this part of the planet was noted again on March 23rd and April 8th, while the darker shading at the junction was seen also on April 1st.

The North Equatorial Belt.—This belt had altered considerably since the previous apparition and had become a much more conspicuous object. It was fairly broad through the greater part of its course, with an irregular outline, and on several occasions narrow white streaks were seen lying along it. On April 9th, at 1h. 58m., the belt appeared very wide at longitude 210°, assuming a wedge shape, the apex of the wedge pointing southwards and reaching nearly to the South Equatorial Belt.

On two occasions a white spot was seen encroaching on the northern edge of the belt. On February 19th, at 0h. 31m., a large white spot was observed indenting the belt in approximate longitude 90° and reaching to the North Temperate Belt. The *following* corner of the hollow formed by this spot was very dark, appearing at a casual glance as a conspicuous black patch. Again, on February 25th, at 0h. 46m., a white spot was observed near the *preceding* limb in approximate longitude 253°.

On the first-mentioned night (February 19th) the bright zone between the North Equatorial and North Temperate Belts appeared as if "covered with massive fleecy cumulus clouds," and again on April 8th, at 0h. 26m., it was remarked "the northern edge of the North Equatorial Belt is slightly wavy in shape, but sharply defined, and there appears to be a row of bright spots all along, looking somewhat like a long bank of mountainous cumulus resting on the top of a range of hills."

On March 9th, at 0h. 9m., the most striking feature on the disc was a dark crimson-brown portion of the North Equatorial Belt, where it curved southwards, taking a V-shape [see chart], the apex of the V being on the central meridian at 23h. 42m., on the 8th, answering to a longitude of 265°·9. Both to east and west of the dark portion the belt became diffused and very much fainter. The same bend in the belt had been observed on March 8th, at 3h. 1m., when it was close to the *following* limb, and was seen again on March 18th, at 2h. 3m., when it was at mid-transit, or in longitude 264°·2. On March 22nd-23rd, this part of the belt had altered considerably in appearance, as an inspection of the charts will show, and further alterations were noted on April 1st and April 8th-9th.

Two short dark patches were seen on the northern edge of the belt on April 29th, in about the same longitudes as two semicircular dark spots on the South Equatorial Belt.

THE BRIGHT EQUATORIAL ZONE.—A far greater number of dusky markings was visible on this zone than was the case during the previous apparition. The usual form observed was that of an irregular arch proceeding from the South Equatorial Belt, and sometimes the space enclosed by an arch would be far brighter than the neighboring areas, as was the case, for instance, with regard to the bright spot seen near the *following* limb on February 19th, at 0h. 31m.

On February 21st and 22nd the arches presented an appearance of great regularity, but on most occasions they were irregular in shape and size, and their side-pillars were frequently inclined towards the *following* limb of the planet's disc.

On March 18th a small round dusky spot, isolated from other markings, was observed on the Bright Equatorial Zone, crossing the central meridian at 2h. 27m. It was described as a "circular spot just like a satellite, but no satellite or shadow was on the disc. The surrounding region, between the festoon to the south and the dark belt to the north, appears to be quite white, whereas that portion of the planet has usually a brownish or reddish tinge." Following this spot was a three-branched mass of shading having a peculiar tree-like appearance and reaching right across the zone from the South to the North Equatorial Belt. On March 23rd the same small spot was seen, followed at a closer distance than formerly by the tree-like shading. The spot transited the central meridian on this night at 0h. 33m., giving for 12 revolutions a period of rotation of 9h. 50m. 30s. On this second occasion the spot appeared to be connected by some faint shading with the southern edge of the North Equatorial Belt. It was not seen again, unless it may be identical with the small dark spot seen at the southern edge of the same belt on April 28th, transiting the central meridian at 22h. 56m., in long 341°·6.

THE SOUTH EQUATORIAL BELT.—The northern component of this belt was usually wide and fairly dark, but it appeared very narrow on a few occasions, as on March 23rd, at 2h. 51m., when it was darker than usual and narrowed down to a fine line near the *following* limb. Again, on April 9th, at 1h. 58m., it was seen much narrower than usual and very dark.

On April 8th, at 0h. 26m., it was noted "the northern edge of this belt has lately been almost straight, but it is now very far from this. At mid-transit the belt becomes so narrow as almost to seem broken, while near either limb it widens considerably," and on April 10th, "belt almost broken in two."

Towards the end of the previous apparition the *preceding* shoulder of the large Hollow in this belt to north of the Great Red Spot was noticed to have turned a deep blood-red color. On the night of February 16th, 1885, this part of the belt seemed to have entirely disappeared, but the definition was noted as not very good, and on March 4th, at 3h. 46m., when this part of the planet was seen again, in place of the fairly broad belt south of the white streak, as shown in the drawings of 1884 (April 20th and May 4th), there was only a faint narrow streak where its southern boundary used to be, separated from the northern portion of the belt by a comparatively wide bright space.

Following the Great Red Spot the shoulder of the Hollow was dark and well-defined, and there was usually, but not always, a white streak dividing the belt longitudinally into north and south components. The invisibility of this streak on some occasions was not due to imperfect seeing, as on March 4th the definition was noted as excellent, but no white streak was seen. On February 19th, the definition being splendid, instead of a longitudinal streak one was seen cutting across the belt at a sharp angle, and on March 10th, with the definition good at times but very variable, the white streak was noticed beginning about 40° east of the Great Hollow. The southern component of the belt grew fainter as its longitude increased, until it appeared as a mere fine line, as described above, separated by a considerable interval from the northern component, and coming to an end in about the position formerly occupied by the *preceding* shoulder of the Great Hollow.

On April 7th, at 0h. 46m., this narrow streak was terminated by a little round dark spot in longitude 352°·6, but on April 9th, at 1h. 58m., the spot had disappeared and the streak appeared to fade off through excessive fineness on approaching the same position; nor was the spot seen on April 9th-10th, or April 28th, when this portion of the planet was again in view. In the drawing taken on June 10th, at 21h. 16m., the definition being good, this streak is not shown at all.

Other special features noted in connection with this belt are as follows:—

On February 19th three dark markings were noticed on the southern edge of the belt, *following* the Great Hollow. The most conspicuous of these markings was described as "intensely black and of a very narrow and roughly oval shape. Its length must be nearly equal to that of the Great Red Spot, but its width is very much less." Following this marking by some 30° of longitude was another small elongated black patch, and following this again, immediately south of a black festoon-pillar rising from the northern edge of the belt, was a small circular spot, almost black in color, and presenting somewhat the appearance of a satellite's shadow. On February 21st the first and most conspicuous of the above spots was noted as "not intensely black to-night, as it was on the previous occasion," and on March 17th it appeared, at mid-transit, of a dark red color. The three spots remained visible throughout the apparition of 1885.

A small portion of the southern component of the belt, to east of the Great Hollow, appeared on one occasion to be partially obscured, as if by a thin veil of cloud. On April 9th, at 23h. 16m., it was remarked "the corner of the dark belt east of the Great Red Spot very sharp, but south edge of belt a little east of this gets diffused and seems to be splitting up. Near the eastern limb the south edge of the belt again becomes dark and well-defined, no doubt owing to the dark streak on the southern edge coming into view." Later on, at 0h. 46m., it was noted "splitting-up appearance of dark belt still noticeable."

THE GREAT RED SPOT.—This marking was plainly visible in 1885, but the majority of the drawings taken show phases of the planet which do not include the Red Spot. The usual appearance of the Spot was that of an oval ring with a narrow belt running off from its *following* end. On February 16th the southern parts of the ring were much plainer and thicker than the rest, the interior being filled in with light shading. On March 4th the Spot appeared as if bent out of shape, the southern edge being nearly straight and touching the northern edge of a broad band of shading, while the Spots' northern edge was very much curved. On March 9th, at 23h. 26m., the Spot was noted as " visible, but its outline is very hard to catch," and it is shown as very faint on the drawing made at that time, and as having a short belt projecting eastwards from its southern boundary. On March 17th also, the Spot was described as being " visible, but very faint," but on April 7th it was seen close to the *following* limb with its outline sharply defined. On April 28th the Spot, close to the *following* limb, appeared of a light pink color and the edge was only a little darker than the interior. The Spot also appeared as if tilted out of its ordinary position on this night, probably owing to indistinct vision, the definition being unsteady except at moments.

THE SOUTH TEMPERATE AND POLAR REGIONS.—On some nights these portions of the planet's disc were quite free from detail, beyond being covered by faint shading. Thus on February 19th, at 0h. 31m., the northern boundary of the South Polar Shading was seen to commence a little way south of the South Equatorial Belt at the *preceding* limb, and dipped southwards on its course to the *following* limb, no markings of any sort being visible upon it. The same appearance was noted on February 21st, at 1h. 2m., ; March 3rd, at 0h. 26m. ; April 10th, at 0h. 46m. ; and April 27th, at 0h. 16m.

On March 4th, the definition being splendid, the South Pole, contrary to its usual aspect, appeared free from shading, both at 1h. 16m. and at 3h. 46m., and was described as follows :—" The shading does not extend to the South Pole, but is cut off sharply by a line in about latitude 50°. This line is well-defined, but does not extend quite unbroken across the planet, for about half-way between mid-transit and the *preceding* limb it is interrupted by a bright patch which extends up from the brighter regions near the pole into the darkish shading of the Temperate Zone." On March 5th also, at 4h. 46m., the observer remarked that he fancied at times he could see a little darkish shading near the Pole, but was not certain of it.

It is remarkable that while on March 8th, with splendid definition, no Polar Shading is shown on the drawing taken at 3h. 1m., the next night, March 9th, at 0h. 9m., when the features near the *following* limb on the previous night were a little way west of the central meridian, the South Polar Cap was not only visible but appeared darker than the shading over the North Pole. On March 10th again, the Polar Shading was faint, but after that date, with the exception of April 8th, it was seen more distinctly.

On most occasions the Polar Shading was fairly uniform in tone, but on February 25th, at 0h. 46m., an oval dark patch, extending some 50° in longitude, was seen immersed in it, and on March 10th, at 1h. 41m., another dark patch was seen, while on March 27th, at 0h. 18m., a narrow curved dark belt, immersed in the shading, reached from limb to limb. On April 29th again, at 22h. 36m., the Polar Cap was described as follows :—" In the Southern Hemisphere the shading is very faint and seems generally to be defined by a line dipping southwards from about the central meridian to the *following* limb. But in moments of exceptionally good definition, I could see several very fine lines running parallel to the Equator from the following limb to near mid-transit, and one fairly well-marked darkish streak in about latitude 45° S.

On April 28th, at 22h. 56m., the Great Red Spot being just within the following limb, a dark narrow belt was seen lying tangential to the south edge of the Red Spot and proceeding in a westerly direction, coming to an end near the central meridian south of this dark belt [compare with 1891] was a narrow white belt joining at the *preceding* end of the dark one with the bright region to north of the South Temperate Belt.

White spots were seen in the South Temperate Regions on the following dates :—

February 25th, 0h. 46m., a white spot near the *preceding* limb in about latitude 40°.

March 9th, 9h. 23m., various white spots [see chart].

April 7th, 0h. 46m., " The northern boundary of the South Polar Shading is uneven and along the edge are several bright spots, and also further south." One very bright spot on the edge of the shading passed the central meridian at 0h. 41m., answering to a longitude of 340°·5.

April 8th, 22h. 46m., a series of white spots was seen forming an interrupted division between the Polar Shading and a dusky streak immediately to north of the spot. Later, at 1h. 58m. (on the 9th), it was noted " the bright mottled streak immediately south of the boundary of the South Temperate Shading seems to finish shortly before mid-transit, but there seems to be another white streak running from limb to limb in about latitude 40° S."

June 10th, 21h. 16m., it was remarked " the northern edge of the shading is a well-defined east and west line, but immediately to south of this is a row of whitish spots, looking like a string of pearls. No other marking is noticeable in this shading except a barely perceptible darkish diagonal patch near the *following* limb."

The following table gives a list of transits of markings over the central meridian of the disc observed during 1885.

The markings can easily be identified by means of the charts.

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.
	1885.	d.	h.	m.	°
NORTH EQUATORIAL BELT—					
Apex of protuberance on north edge	Mar.	10	2	13	147·5
Apex of wedge at southerly bend of belt	"	8	23	42	265·9
Dark triangular protuberance on south edge of belt, probably identical with the above	"	15	4	28	260·9
Apex of bend, where belt dips southwards	"	18	2	3	264·2
Dark spot on south edge of belt	"	22	22	41	173·8
Dark spot at apex of triangular protuberance from south edge	April	28	22	56	341·6
BRIGHT EQUATORIAL ZONE—					
Dusky spot near south edge of the North Equatorial Belt	Mar.	18	2	27	278·7
" " "	"	23	0	33	241·5
SOUTH EQUATORIAL BELT—					
Triangular protuberance on north edge	Mar.	15	2	4	173·9
Festoon-pillar north of the Great Hollow	"	16	23	14	11·8
Dark spot at base of festoon-pillar	April	7	0	25	330·8
White spot on north edge	June	10	21	16	256·0
Black spots on south edge of belt—					
First of three, *f* end of spot.......................	Mar.	17	1	22	89·1
Second spot of three	"	10	1	41	128·2
Second spot of three	"	27	0	46	130·5
Last spot of three	"	10	2	15	148·7
Dark spot terminating the narrow streak, where the *preceding* shoulder of the Great Hollow used to be ...	April	7	1	1	352·6
Angle of shoulder of the Great Hollow, *following* the Red Spot	Mar.	16	23	46	31·1
THE GREAT RED SPOT—					
Following end..	Mar.	24	0	32	31·2
Preceding end (approximate)	April	9	23	16	19·8
SOUTH TEMPERATE BELT—					
Bright spot	April	7	0	41	340·5
"	"	14	0	9	292·8

REMARKS, 1886.

During this apparition 53 sketches were taken, showing a good amount of detail on the planet. Markings on the Bright Equatorial Zone were fairly distinct and the two dark Equatorial Belts were subject to striking changes of form. The Polar and Temperate markings were also fairly distinct, though as usual not much detail could be seen there. It is noteworthy that a small dusky spot, similar to that seen in 1884, was again visible in South Temperate Regions. It was not seen in 1885.

North Polar and Temperate Regions.—The markings in these regions usually consisted of a more or less distinct Polar Shading, with one or two narrow belts south of it. On December 1st, however, at 6h. 1m., no Polar Shading could be distinguished at either pole, though the definition was very good, and the same remark applies to the drawing made on December 10th, at 6h. 16m.

Usually the Polar Cap was of fairly uniform shade throughout, but on March 23rd, at 4h. 1m., and April 7th, at 0h. 36m., it was observed to have a dark shading on its southern edge, in both cases at the *following* limb of the disc.

The North Temperate Belt on March 23rd, at 4h. 1m., had a decided bend to the north as its longitude increased, and its northern edge was marked by a fine dark line, making it appear (as described in the remarks written at the time) almost like two belts. On March 28th, when this portion of the planet was again in view, two narrow belts were seen at the *preceding* limb, but in approximate longitude 52° they joined together to form one narrow belt no wider than either of the components. In approximate longitude 100° the belt again became double, the southern component being dark and the northern comparatively faint [see chart], but both very narrow.

On April 7th, between longitudes 65° and 100°, the North Temperate Belt had a short belt, broader and slightly darker than itself, superposed upon it, and this was again seen on April 11th and 18th, and perhaps in its earlier stages of development on February 22nd, when a portion of the belt between longitudes 25° and 89° (approximately) was seen darker than the rest but of only the same breadth.

The North Equatorial Belt.—This belt underwent constant changes of form, and only a few of its more improtant features can be mentioned. The southern edge was frequently connected with shading on the Bright Equatorial Zone, and the belt often exhibited an appearance as if composed of different layers of matter. See, for instance, the drawings made on January 14th, at 4h. 36m. (*c.m.* 337°·5); February 5th, at 4h. 6m., (*c.m.* 27°); February 7th, at 5h. 21m. (*c.m.* 13°·1); February 18th, at 3h. 41m. (*c.m.* 167°·0); and others.

On January 25th, in longitude 250°, an appearance was seen which was frequently noted during this apparition. It was that of a very fine and very dark line running along the North Equatorial Belt. The same appearance was noted again on February 6th, longitude 160° to 198°. On April 3rd too, at 4h. 26m. (*c.m.* 331°·7), a narrow dark line of similar character was seen starting at the *following* limb from the middle of the belt, rising rapidly to the northern edge, where it bounded a triangular protuberance, and crossing as rapidly again to the southern edge, along which it ran for some little distance to longitude 329° (approximately). Then came a circular indentation in the belt, shallow but sharply defined [see chart], and the dark line still followed the contour of the belt and came to an end at the *preceding* angle of the indentation in about longitude 312°. A similar dark line was seen on April 7th, at 0h. 36m., but on that occasion it did not appear quite so sharply defined, though two days later, on April 9th, at 1h. 56m., the same line was again seen, and this time more distinctly. These lines did not fade away into the substance of the belt but were firm, distinct lines, sharp and well defined.

The drawing of February 4th should be noted for the way in which the two halves of the North Equatorial Belt duplicate each other. Such " shoulders " as are shown there are common features of the belt, but it is not often two such " shoulders " are to be seen at once on opposite (north and south) sides of the belt. The shoulder on the northern edge is shown again in the drawing made February 6th, at 4h. 10m. To the western side of the " shoulder " the belt is shown double and the northern component comes to a club-shaped termination just *preceding* the shoulder. This club-shape, also, is not an uncommon feature.

The drawing taken February 8th, at 4h. 37m., (central meridian 136°·9), shows the belt as if it were *split open* by a narrow wedge of white cloud, instead of the white cloud appearing merely to overlie the belt. See also the drawing made January 22nd, at 4h. 6m. (central meridian 82°·0), where a pear-shaped white spot in the middle of the dark belt has the appearance of forcing its way through the latter, causing the belt to bulge out on either side.

Small dark patches or spots were seen on this belt on February 9th in longitudes 271°-285°, and on March 26th in longitude 184°. On February 18th, at 3h. 41m. (central meridian 167°·0), a dark shade is shown on the southern edge of the belt, nearing the *preceding* limb, and this is connected by a sloping line of faint shading with a small dark patch on the northern edge of the South Equatorial Belt. This dark patch may be identical with the fine dark line shown in slightly greater longitude on the drawing made February 6th, at 4h. 10m.

In the drawings made April 5th, at 3h. 42m., April 5th, at 23h. 26m., and April 6th, at 0h. 16m., the form of the southern component of the belt is worth noting, while the drawing made on May 13th (central meridian 140°·0) is also noticeable on account of the short dark belt which appears superposed on the North Equatorial Belt and juts out into the bright zone to the south.

White spots were occasionally seen in connection with this belt. On February 18th, at 3h. 41m., a large round white spot was visible, resting in a hollow in the northern edge of the belt, and reaching to the North Temperate Belt. Measured on the drawing the white spot lies in approximate longitude 191°. It was seen again on April 7th, at 3h. 6m., but on March 26th and April 5th, when the same part of the planet was in view, no white spot was seen, though the definition was very good on each occasion. On April 26th, at 23h. 35m., the same white spot was seen, but it was fainter than before, and the belt south of it had altered considerably, the northern component being a continuous belt on which the white spot appeared to encroach.

On May 2nd, about 170° of longitude from the above-mentioned spot, another large white spot was seen, also filling a hollow in the North Equatorial Belt and reaching to the first dark belt to the north. A companion spot was seen, a little *preceding* the above, on the southern edge of the belt, but this spot was not a complete circle but only a semicircle, appearing to be cut off sharply by a dark offshoot from the belt.

A white spot, surrounded by dusky shading which threw it into relief, was seen encroaching on the southern edge of the belt on April 5th and April 7th.

On February 22nd, at 3h. 56m. (central meridian 57°·6), a white streak dividing the belt lengthways was noted as being very bright. It was remarked " Near the limb the white streak is not very bright, but from where it turns southwards to where it joins the Equatorial Bright Belt it is brilliantly white, appearing luminous, and is by far the brightest part of the planet. The streak is not perfectly even and straight but is slightly irregular."

THE BRIGHT EQUATORIAL ZONE.—This zone had usually a good deal of shading on it, connected with either the south or north Equatorial Belt. Occasionally these two belts were seen as if intimately connected. For instance, on January 22nd, in longitude 70°-80°, a dark protuberance rose from each belt, sloping towards each other, and having their extremities connected by a line of faint shading. The drawing made February 21st, also, at 4h. 4m., shows a dark projection from the northern belt proceeding southwards and joining with the club-shaped end of a dark section of the southern belt, and in this case the physical connection of the two belts appears to be very clearly shown.

A characteristic appearance is shown in the drawing for February 22nd, where the festoons are seen to rise from dark prominences on the southern belt. This was a case of very frequent occurrence. Indeed it was seldom a dark prominence was seen on that belt during 1886 without a festoon or a pillar of shading proceeding from it into the Bright Equatorial Zone.

On April 7th, at 0h. 36m. (central meridian 74°·1), a large white spot was seen at mid-transit. It was merely the space enclosed by a small festoon rising from the South Equatorial Belt, but was much brighter than the neighboring areas. On April 9th, at 1h. 56m., (central meridian 63°·2), another white spot was seen at mid-transit, but this one had no festoon-pillar on its *following* side and was not nearly so striking an object as that seen two days before.

THE SOUTH EQUATORIAL BELT.—This belt, like its northern colleague, underwent constant changes of form, and it usually had small projections on its northern edge from which festoon-pillars arose. The belt was double for a great part of its course, but for some distance *preceding* the Great Red Spot it appeared as a single belt only, frequently being very narrow. On two occasions, April 26th, at 20h. 26m., and April 28th, at 20h. 46m., a fine line was seen *preceding* the Great Red Spot in the place where the southern edge of the belt used to be in 1884, and identical with the fine line seen in the same position in 1885. On April 26th the line was only "suspected of being visible," but on the 28th it was fairly plain, the quality of the definition being about the same on the two nights. No drawing, however, was made on either of these occasions.

A dark spot on the southern edge of the belt, *following* the Great Red Spot and identical with the first of the three spots noted there during the previous apparition, was seen on December 14th, 1885, at 6h. 46m., in approximate longitude 45°, and was observed again as a fine dark streak, but in greater longitude, on January 12th, 1886. On January 22nd it was remarked "there is just a trace of a dark patch on the southern edge of the belt,"and the spot is shown again on the drawing taken March 28th, at 2h. 6m., in longitude 90°-100°, but it was not seen on intermediate dates, nor on any subsequent occasion.

On January 12th, immediately *following* the dark streak above referred to, the central parts of the belt seemed to be almost blotted out, the north and south boundaries retaining their distinctness, and on January 26th, in the same region, the belt was noticed to suddenly become much fainter east of a dark protuberance.

This sudden decrease of shade was observed again on other occasions. Thus on February 3rd, at 3h. 52m., the northern component of the belt had regained its usual dark shade, but the southern component was still very faint at part of its course, and narrowed down to a fine line, coming to an end in about longitude 135°. On March 15th, again, the belt was sharply divided into dark and light portions without any gradation of shade. Just *following* the Great Red Spot the belt was dark and well defined, but a little way further to the east it suddenly became faint [see chart]. This effect seems to have extended also to the prominence jutting out from the northern edge, the intensity of its shade suddenly decreasing in much the same line as that of the belt itself.

On January 25th, at 6h. 11m., the belt was observed to be quite broken across near the central meridian (248°·6), a white space, extending over nearly 20° of longitude, separating the two portions. In the centre of this space a very faint bit of shading could be seen, perhaps due to a small portion of the belt being visible through a thin place in an overlying white cloud. The dark South Temperate Belt was also nearly broken through in about the same longitude as the South Equatorial Belt. The drawing taken on this occasion should be compared with those made in 1885 (December 1st and December 13th), the same portion of the planet being in view but having very different aspects.

A similar break in the South Equatorial Belt was seen on February 4th in longitude 192°-208°, but the two parts of the belt were not entirely disconnected, the space between being filled with very light shading. This break was seen again two nights later, on February 6th, at 4h. 10m., when it had changed considerably in appearance [see chart], and on February 8th it had undergone still further changes. On the 9th it was observed (though not as an absolute break) near the *preceding* limb of the planet, but on the 18th, at 3h. 41m., when it should have been in view, no such break was noticed, the belt consisting of two short dark belts on a background of lighter material, and on March 26th the belt, at this part of the planet, had regained its usual dark shade. But on April 5th, at 2h. 23m. (central meridian 198°·0), a total change had again taken place. The definition was very good, and two decided breaks were observed, while the structure of the belt seemed to have changed alogether from what it was on March 26th. The second of the two breaks seen on April 5th was in almost the same longitude as the break first observed on January 25th. The next night (April 5th-6th) this break was seen again and was found to be followed by yet another one in about longitude 300°, the belt presenting a general appearance of disintegration.

On April 17th, at 0h. 21m. (central meridian 128°·4), the northern component of the belt was split up into short disconnected lengths, but the southern component, fainter than the other, was visible right across the disc as a continuous belt. When this part of the planet was in view on April 26th-27th, it presented a somewhat different appearance, the short dark belts not being altogether isolated but resting on the northern edge of the fainter shading which on the previous night (April 17th) formed the southern component of the belt and which had since then increased considerably in width. On May 13th, at 21h. 59m., the same part of the planet being in view, a sharply defined narrow white streak in longitude 145° (approximately) was observed to cut the broad northern component of the belt straight across, perpendicular to its length. The southern component of the belt was narrow and faint, and though it was suspected that the white streak divided that also, it could not be made a matter of certainty. The drawings made April 26th and May 13th should be compared with each other, to show the complete change that had taken place in the Equatorial Belts during the intervening 17 days.

While angular projections are common features on the northern edge of the South Equatorial Belt, they are not so frequently seen on the southern edge, but on February 6th the belt was widened both to north and south in longitude 238°, a little way past the central meridian, as if a triangular piece of shading had been added on to both sides.

On February 18th, at 3h. 41m., the belt presented the appearance of short dark belts superposed on a more lightly shaded background, the latter seeming to be the true South Equatorial Belt, with straight regular edges. The same appearance is shown on the drawings made on February 21st and April 7th. On the last-mentioned date two white spots were seen immersed in the belt. The *following* spot was bright, and was situated at the *preceding* end of a short dark belt. Both spots were completely surrounded by shading, and the more *preceding* of the two almost touching the other one was described as not white, but only lighter than its surroundings.

The drawing made April 11th, at 2h. 35m., shows a small round knob in longitude 8°, dark and well defined, projecting from the northern edge of the belt. It is one of the few instances of such a marking being unconnected with any festoon-pillar or other visible shading on the Bright Equatorial Zone.

THE GREAT RED SPOT.—The Great Red Spot was usually very plainly visible during this apparition, and it still had the appearance of an oval ring filled with light shading.

On the 14th of January and the 3rd, 5th, and 7th of February, the Spot was seen completely isolated, but the drawing of February 9th shows a fine narrow belt or streak curving northwards to meet the *following* end of the Spot, while another very fine and very faint streak runs horizontally from the *preceding* end of the Spot to about longitude 265°. On the 9th the *following* end of the ring-boundary of the Spot was much darker than the rest.

On February 22nd, the Spot being near the *preceding* limb of the planet. a narrow belt was seen *following* the Spot in a line with its southern boundary. It could not then be definitely determined whether the belt joined with the Spot, but two nights later (February 24th) it was particularly noticed that the belt did not join with the Spot, but was bent to the south just a little distance east of it, joining with a broad shaded belt to the south. The space between the Spot and the belt, where the latter turned off southwards, was extremely narrow and could only be seen at moments of best definition.

On March 10th the ringed appearance of the Great Red Spot was more pronounced than usual, and a short narrow belt was seen projecting horizontally from its *preceding* end, while a dusky shading at the *following* limb of the planet connected the Spot with the South Temperate Belt. This was seen to more advantage on March 15th, when the South Temperate Shading appeared to rise in a mound to meet the *south-following* end of the Spot. On April 11th the Spot again appeared isolated, except for a fine and very faint streak issuing from its *preceding* end. This streak was also well seen on April 3rd, when the Spot was close to the *following* limb.

The southern edge of the ring-boundary on April 11th, at 2h. 35m., was much thicker and darker than the northern edge, but the darkest part of all was just at the *following* end of the Spot. Eight days later, on April 18th, at 23h. 6m., the ring appeared uniform both in thickness and in depth of shade.

On some occasions the South Temperate Shading had a deeper shade than common immediately south of the Great Red Spot.

The following remarks with respect to the Spot's appearance were made during this apparition, 1886 :—

February 3rd, 2h. 25m., " The Spot consists now of a reddish ring filled with lighter matter of a pinkish color. . . . . The south edge of the ring is darker than the north edge, but the darkest part of all is just at its *following* end, where there appears to be a small dark knot. At the *preceding* end the northern edge dips down " (*i.e.*, southwards), " and the southern edge is almost straight."

February 5th, 4h. 6m., "The Great Red Spot is hardly so conspicuous as on February 3rd, and does not show the appearance of a ring so plainly, the edge being very little darker than the inside shading, which is, as usual, of a light pinkish color."

February 9th, 6h. 46m., "Dark marking on *following* end of Great Red Spot."

April 3rd, 4h. 26m., "The *preceding* end of the Great Red Spot is pointed. . . . . The Great Red Spot itself is a light pink color." (The Spot on this evening was close to the following limb.)

April 11th, 2h. 35m., "The southern edge of the Spot is a good deal thicker and darker than the northern edge, but it is darkest of all just at its *following* edge."

April 20th, 3h. 18m., "The Great Red Spot, owing probably to it being so near the limb, appeared very flat, with no darker ring round it as it usually has. I could not decide whether it was pointed or not at the *preceding* end."

A few transits of the Great Red Spot over the central meridian of the disc were observed, and will be found in the table of central transits given at the end of this year's observations.

THE SOUTH TEMPERATE AND POLAR SHADING.—The South Temperate Shading during this apparition showed at times a considerable amount of detail, chiefly in the form of white spots in longitudes *following* that of the Great Red Spot. Perhaps, however, the most remarkable feature was the reappearance of the isolated dusky spot seen in 1884. Its appearance on February 3rd, 1886, when it was just past the central meridian at 3h. 52m., in approximate longitude 73°, was very similar to that which it had in 1884, except that the spot, instead of being round, had become pear-shaped, with its smaller end turned to the west. A narrow belt on each side came to an end before reaching the spot, and the shading to the south had a darker shade immediately south of it, but there was no dip southwards of the edge of the shading as in 1884, perhaps on account of the broader white space interposed between the shading and the spot (and belts) to the north. The narrow dark belt *following* the spot was noticed to be uneven along its southern edge, and this was much more conspicuous the next time the spot was seen, on February 8th, at 3h. 5m. The *preceding* end of the belt following the spot then passed the central meridian at 3h. 11m., answering to a longitude of 84°·9, and the southern edge of the belt had a scolloped appearance, which may perhaps have been due to white spots encroaching upon it. The spot was seen again on February 22nd, at 3h. 56m., but not on any subsequent occasion. It was then about 10° *following* the central meridian, or in approximate longitude 68°.

On February 5th, at 4h. 6m., the South Temperate Shading had a sharp angular shoulder answering to that of the South Equatorial Belt, and in about the same longitude with it. The two belts curved away symmetrically with the southern and northern edges, respectively, of the Great Red Spot. This angular shoulder of the South Temperate Shading was seen again on February 7th, and on March 15th (as already noted in the remarks on the Great Red Spot) a mound of shading was seen in the same region joining with the *south-following* end of the Spot. On intermediate dates, however, a different appearance was observed, as on February 9th and 22nd [see charts].

On March 18th, at 4h. 46m. (central meridian 97°·5), and March 23rd, at 4h. 1m. (central meridian 102°·3), a number of white spots seemed to be arranged along the narrow white belt separating the South Temperate Shading from the next dark belt, close to it, to the north, and on March 28th, the Great

Red Spot being near the *preceding* limb, a series of irregular white spots was observed in the South Temperate Shading, there being then no distinct belt to the north.

On April 7th, 9th, 11th, 18th, and 27th, round white spots were again seen at this part of the planet. On the 7th the most westerly of the spots was seen to have an outlet connecting it with the bright zone south of the South Equatorial Belt, close *following* the Great Red Spot. This was seen to more advantage on April 9th, and still better on April 11th, when more centrally placed. From the place of junction a short wedge-shaped white streak went off in a *south-preceding* direction, and on April 18th the shading on the *preceding* side of this white streak was very much darker than that *following* it. Only the latter part contained the white spots, none being visible on the darker shading. On April 26th-27th, the spots were found to come to an end in about longitude 110°, the belt being there split into two narrow belts by a white cloud which lay over its central parts [see chart].

The South Polar Cap was on some occasions very faint, but on others plainly visible. It could not be seen at all on December 1st and 10th, 1885. Sometimes it appeared to extend a great distance to the north and no division would be seen separating it from the South Temperate Shading, and at other times it would be confined to high latitudes. The northern boundary of the Polar Cap was not always parallel to the Equator, but was sometimes curved or inclined, as on February 6th and 18th, April 17th, and May 13th.

The following table gives a list of transits of markings over the central meridian of the disc, observed during 1886.

The markings can easily be identified by means of the charts.

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.
	1885.				°
NORTH EQUATORIAL BELT—		d.	h.	m.	
Indent in southern edge	Dec.	14	6	46	77·2
	1886.				
Preceding end of dark belt lying along the North Equatorial Belt	Feb.	7	4	53	356·2
SOUTH EQUATORIAL BELT—					
Following end of break in belt	Feb.	4	3	19	208·2
Festoon-pillar	"	4	3	48	225·8
Festoon-pillar north of the Great Red Spot	"	5	3	42	12·5
Festoon-pillar *following* the last-mentioned one	"	5	4	21	36·1
Dark mound, closely *preceding* the break in the belt	"	6	4	10	179·8
Following edge of festoon-pillar north of the *preceding* end of Great Red Spot	"	7	4	58	359·2
Angular shoulder on southern edge, *following* the Great Red Spot	"	5	4	6	27·0
Brilliant white spot on northern edge	April	7	0	36	74·1
THE GREAT RED SPOT—					
Following end of spot	Feb.	3	2	25	25·3
" "	"	5	4	1	24·0
Preceding end of spot	"	7	4	56	358·0
Following end of spot	April	11	2	35	27·4
SOUTH TEMPERATE REGIONS—					
Preceding end of narrow belt *following* small dusky spot	Feb.	8	3	11	84·9

REMARKS, 1887.

Only three drawings were taken during this apparition, but each shows features of its own. In the first, April 24th, 1h. 36m. (central meridian 242°·2), the South Equatorial Belt is shown immersed, as it were, in a sea of lighter matter which extends both north and south of the belt and is connected with the North Equatorial Belt by two sloping areas of shading. The South Temperate regions also are worthy of notice, with the swelling on one dark belt, and the corresponding northward curve of the dark belt to the north, which there narrows down to a fine line.

In the second drawing, taken May 16th, at 1h. 26m. (central meridian 304°·2), the Northern Hemisphere shows the greater amount of detail, and especially the North Equatorial Belt.

The third drawing, taken on July 11th, at 22h. 1m. (central meridian 276°·7), shows still more detail in the North Equatorial Belt, and the curved dark belt on the North Polar Shading should be noticed, being similar in appearance to the two dark belts lying along the southern edge of the North Equatorial Belt.

In none of these drawings is there much detail shown on the Bright Equatorial Zone ; indeed, the last one shows nothing there but a white spot which touches the northern edge of the South Equatorial Belt about 25° to east of the central meridian, or in approximate longitude 302°.

REMARKS, 1888.

This year only seven drawings were taken, one each in May, June, and July, and four in August.

The North Temperate Belts, two in number, are shown on June 15th, at 0h. 56m., as coming to an end in longitudes 19° and 28°. The more northern of the two belts is a very faint narrow streak, while the other from the *preceding* limb to the central meridian is much broader, though still only a narrow belt, and fairly dark. The latter, however, suddenly becomes faint near the central meridian (2°·8) and fades off to invisibility before reaching halfway from the central meridian to the following limb.

On July 31st three belts were seen in North Temperate Regions, there being two narrow but fairly distinct belts with a very fine and faint streak between them. The faint streak carried on it a short belt, much darker and broader than itself, with its preceding end in approximate longitude 53° and extending through some 26° of longitude. On August 7th only one belt, and that a fairly broad one, was seen in these regions, and this had a short dark streak along its northern edge, in much the same longitude as the short belt mentioned above. The North Polar Cap had also, at the same time, a short narrow belt, of darker shade than itself, on its southern edge near the preceding limb.

The North Equatorial Belt.—On May 17th this belt had two white streaks running along it in the same line, one from the *preceding* and the other from the *following* limb, almost but not quite meeting together. It seems probable from their appearance that they were parts of one and the same streak, and that an outburst of dark matter had covered and hidden the streak at one particular point and had thus formed an apparent break in it. In that case the dark matter would be at a higher level than the white. at this part of the planet, and the way in which the belt suddenly becomes darker at the end of the more westerly white streak seems to indicate the presence of two different layers of dark matter, one at a lower level than the other. All the drawings made during this apparition show white streaks on the North Equatorial Belt, but very little other detail is shown in the three sketches made in May, June, and July. In the August drawings the belt shows more variety of shading.

THE BRIGHT EQUATORIAL ZONE.—Very little detail was seen on this zone, and, with the exception of the drawing made on May 17th, only a few faint streaks are shown on the sketches.

THE SOUTH EQUATORIAL BELT.—The dark northern component of this belt was noticed on May 17th (central meridian 288°·7) to have a kind of metallic lustre.

The angular shoulder on the southern edge of the belt, *following* the Great Red Spot, was noticed to be very dark and sharply defined on June 15th, much more so than the rest of the belt.

On two nights the southern edge of the belt was seen to depart from its usual straightness. On August 3rd an angular projection was seen on the southern edge in longitude 204°, and on August 7th two small angular projections were seen on this edge, just *following* the Great Red Spot, answering to two similar projections in almost the same longitudes on the northern edge.

On August 7th, at 23h. 21m., the northern component of the belt was cut perpendicularly across in approximate longitude 127° by a narrow white streak, as was the case in a slightly different longitude on May 13th, 1886. On the same night (August 7th) three dark mounds were seen rising from the northern edge of the belt, the first and second being of the usual dark reddish-brown color, while the third, or most easterly one, appeared of a livid hue, similar to that seen when viewing objects by the light of a sodium flame.

THE GREAT RED SPOT.—The Great Red Spot was seen on three occasions, on one of which, however, it was close to the preceding limb and very faint. On June 15th it was near the central parts of the disc and had a peculiar appearance [see chart]. The definition was variable and to this cause the dip of the Spot southwards must be ascribed, though very good glimpses were obtained at times. Centrally south of and touching the Great Red Spot was a small round white spot, one of a number of such spots visible in the same latitude and *preceding* the Red Spot. The combined effects of contrast and variable definition caused the Red Spot to appear as if it curved inwards at the point of contact, as shown on the chart.

On both June 15th and August 7th the Spot appeared as a ring filled with faint shading, the southern edge of the ring being in both cases darker than the rest of it.

THE SOUTH TEMPERATE AND POLAR REGIONS.—The markings here were fairly plain in 1888. White spots were seen on June 15th and July 31st, one of which, on the former date, appeared to touch the Great Red Spot, as mentioned above. On July 31st only one spot was seen, closely following the Great Red Spot.

On August 7th, at 20h. 41m., it was noted "at times it appears as if there was a row of brilliant pearls following and to the south of the Red Spot, but in moments of best definition they resolve themselves into the wavy appearance of the dark belt next to the South Polar Cap, as shown in the sketch."

The South Polar Cap was at all times fairly distinct.

REMARKS, 1889.

No detailed remarks were made this year, so the following notes have been gathered from the drawings, which number 43. On many occasions several drawings were taken the same evening; thus on May 15th five drawings were made, from 1h. 56m. to 5h. 16m.; May 16th, four, from 1h. 56m. to 4h. 26m.; June 23rd-24th, nine, from 22h. 46m. to 6h. 12m.; July 2nd-3rd, seven, from 22h. 39m. to 3h. 41m.; and July 17th-18th, five, from 21h. 46m. to 1h. 6m., thus showing a large portion of the planet on each occasion.

On June 23rd-24th, when nine drawings were taken, the first and last sketches overlap each other slightly, but the parts common to both do not fit in together so well as they should do. On May 16th also, the South Temperate Regions in the different sketches did not agree well together, but when the later sketches were made that night the planet was covered with thin cirro-stratus which hid all the fainter detail.

During the apparition of 1889 the planet showed a great quantity of detail in its Equatorial Regions, while in South Temperate Regions there was a small isolated spot similar in appearance to those noticed in 1884 and 1886, and on two nights an elliptical ring was seen in these regions between longitudes 180° and 210°.

The North Polar and Temperate Regions.—As usual not much detail was visible in these parts of the planet. The North Polar Cap had a short length of dark shading on its southern edge on several occasions, as has been noted in previous years, but otherwise no detail was visible there.

On May 15th the North Temperate Belt was observed to split or fork into two belts in about longitude 271°, but this forked appearance was not noticed again. On June 24th the belt was interrupted for a space of some 35° between longitudes 185° and 220°, and had a fainter and narrower companion belt, a little further to the north, reaching from longitude 200° to 325°. On the next night [June 25th] the belt is shown as coming to an end in about longitude 171°.

On June 25th, at 22h. 44m., the North Temperate Belt is shown as displaced to the north between longitudes 198° and 229°.

The drawing made July 2nd, at 22h. 39m., shows an uncommon feature in the short belt projecting obliquely from the North Temperate Belt in about longitude 205°, and slightly darker than the rest of it. By 1h. 9m. the same night (central meridian 291°·5) the North Temperate Belt, seen earlier as fairly broad, had by degrees become narrower and in about longitude 295° another belt began to the south of the old one. Later, this new belt was by far the more conspicuous of the two, the more northern belt having dwindled down to a narrow line.

The drawing made July 17th, at 21h. 46m., shows the North Temperate Belt to be partially, but not quite, blotted out between longitudes 239° and 251°, the same appearance being observed also on the North Equatorial Belt, as if both belts were affected by one and the same cause.

The North Equatorial Belt.—This belt showed frequent changes of form. The drawings of May 15th show a succession of short dark belts along its southern edge, with two small dark markings separated entirely from the belt, though evidently physically connected with it. The second of these small dark markings fitted into a large hollow or bay in the southern edge of the belt, similar to the Great Hollow formerly visible in the South Equatorial Belt to north of the Great Red Spot, though not so large. This "hollow" proved to be a fairly stable feature, being seen again on June 23rd, at 22h. 46m.., June 25th, at 23h. 34m., and July 2nd, at 23h. 34m. On the last-mentioned date the "hollow" preceded its former position by some 60° of longitude, and may have been not the same feature but a new development, as the belt had been undergoing great changes of form.

On June 25th, at 22h. 44m., a small white cloud-streak was noticed, projecting into the southern part of the belt in about longitude 225°. When this part of the planet was again seen, on July 2nd, at 23h. 31m., the streak had elongated itself in a remarkable manner, having then the appearance of a long white streak with two spots threaded on it.

The appearance of the belt on July 3rd, from longitude 300° to 30°, was most remarkable. It was extremely difficult that night to make satisfactory drawings, as the definition was variable and the true forms of the markings hard to make out, but the chart shows fairly well how the belt appeared, and it is corroborated to some extent by a drawing by Prof. Keeler in vol. ii. of the Publications of the Astronomical Society of the Pacific, No. 11.

On July 10th, at 2h.11m., another curious feature was observed, in the dark narrow bent belt projecting from the southern edge of the North Equatorial Belt in about longitude 300°, the markings at this part of the planet having changed entirely in appearance during the seven days that had elapsed since the drawing of July 3rd was made.

On July 17th, at 21h. 46m., the belt appeared partially blotted out between longitudes 243° and 253°, as was noted in the Remarks on the North Temperate Belt, which was included in the partial obscuration.

A small but brilliant white spot was observed on July 31st, at 21h. 55m., at the following end of a short dark belt on the southern edge of the North Equatorial Belt, in about longitude 248°.

On September 1st, at 22h. 51m. (central meridian 15°·0), the belt appeared split up into various forms, but in increased longitude, at 0h. 50m., on the 2nd (central meridian 86°·9), it became a broad even belt, devoid of detail except for a small dark smudge on its northern edge near the central meridian.

THE BRIGHT EQUATORIAL ZONE.—This zone generally presented a fair amount of detail, but there was nothing requiring special mention, except perhaps the broad mass of shading rising from the central parts of the South Equatorial Belt on July 17th, at 22h. 36m., between longitudes 281° and 293°.

THE SOUTH EQUATORIAL BELT.—This belt, like its northern colleague, underwent frequent changes of form, and showed a good amount of detail.

On May 16th, in longitude 323°, a curious little dark spot was observed rising from a hollow part of the belt, where the latter had thinned down to a narrow streak. It was connected with shading on the Bright Equatorial Zone. The same night, at 4h. 26m., the belt was seen cut across, but not perpendicularly, by a straight and narrow white streak, which cut the northern edge of the belt in about longitude 31°, and the southern edge in about longitude 39°. To east of the white streak the belt was much fainter than to west of it.

On July 3rd the belt presented rather an unusual appearance in the region preceding the Great Red Spot, as did also the North Equatorial Belt in the same longitudes [see chart].

THE GREAT RED SPOT.—This marking was seen on seven occasions and had its usual aspect of a ring filled with lighter shading.

The chart for May 14th does not represent its shape properly. It was noted that night as appearing much flatter than usual, as if the north and south edges had been squeezed together, and is so shown on the original drawing, the ends being shaped more squarely than usual. The Spot was then quite isolated from other markings, as was the case also on May 16th.

On June 24th the spot appeared to be connected with a faint narrow belt to the eastward, which curved northwards to meet the *following* end of the Spot. On July 3rd it was again seen connected with a belt following it, but this time the belt appeared to run parallel to the Equator and to join with the southern edge of the Red Spot. This edge appeared considerably darker than the rest of the ring, of the same depth of shade, in fact, as the belt joining with it. On July 15th the same appearance was noted, but the belt joining with the Spot was a very short one and came to an end in about longitude 22°, though after a gap of only about 6° another belt took its place in nearly the same latitude. The same thing was seen again two nights later, July 18th, the Great Red Spot being then shown as very faint.

On September 1st, at 22h. 51m., the Spot appeared completely isolated again.

The South Temperate and Polar Regions.—These parts of the planet showed rather more detail than is usually the case. Perhaps the most remarkable feature was the appearance of an isolated dark spot, similar to those seen in 1884 and 1886. It was first seen this year on May 15th, when it was drawn as a fair-sized spot, roughly oval in shape, almost touching the northern edge of the South Temperate Shading. The position of the spot on two drawings made at 1h. 56m. and 2h. 46m., respectively, shows a difference of about 11° of longitude, and for the chart a mean of these two positions has been adopted and the spot shown in longitude 166°. As in 1884 and 1886, the belts on either side of the spot came to an end a little way from it, but both the spot and the belts on either side were much darker and rather larger than in the previous years. The belts, this year, appeared joined on to the shading to the south.

On June 24th the spot was again visible, and on June 25th, at 0h. 24m., it was seen on the central meridian (longitude 141°·2). It was noticed again on August 21st and September 2nd. On August 21st the belt *preceding* the spot had lost its distinctive shade and had become a part of the South Temperate Shading, and on September 2nd the *following* belt had also lost much of its intensity, though it was still darker than the shading to the south.

On June 24th, at 6h. 12m., a remarkable hollow ring was seen near the central meridian (201°·1). The ring was oval in shape, with pointed ends, and was joined on at each end to a belt continued to the planet's limb. South of this oval ring the edge of the broad South Temperate Shading dipped southwards, the white zone separating the shading from the ring and belts being of uniform width all along. The ring was seen again on July 2nd, when its *following* end was near the central meridian at 22h. 39m. (longitude 200°·8). This time the ring was obliquely situated, instead of having its major axis parallel to the Equator, and the north and south sides of the ring were much fainter than the *preceding* and *following* ends. A considerable space intervened between the ring and the shading to the south, and no southward dip of the northern edge of the shading was observed. This part of the planet was seen again on July 31st, at 21h. 55m. (central meridian 214°·0), but the ring was not noticed. It would have been near to the *preceding* limb of the planet.

A white spot was observed on July 18th, at 22h. 20m., at about mid-transit, or in longitude 75°·1. It was wholly immersed in the South Temperate Shading, and was connected with arched white spaces which reached to the *preceding* limb. The spot, however, was much brighter than the other white spaces.

The South Polar Cap was in most cases separated from the South Temperate Shading by a bright zone of moderate width.

REMARKS, 1891.

In 1891 the observations were more systematically taken, spots being timed in their transits over the central meridian and a few latitude measurements made. Owing, however, to illness of the observer and also to continued bad definition, the observations extend over a short period only, from August 5th to October 18th, with one additional sketch taken on December 2nd.

Forty-six drawings of the whole disc were made, and one drawing on September 30th showing South Temperate and Polar Regions only, making 47 in all. They were thus apportioned :—August 5th, six drawings ; August 24th, one, unfinished owing to cloud ; August 28th, three ; September 5th, one ; September 9th-10th, eight ; September 15th-16th, three ; September 18th, one ; September 19th-20th, three ; September 21st, one, not quite finished owing to clouds ; September 25th, one ; September 27th, three ; September 29th-30th, two, and one showing only part of the disc ; October 7th-8th, six ; October 9th, one ; October 14th, two ; October 17th-18th, three ; and December 1st, one.

During 1891 the atmospheric conditions at Adelaide were very unfavorable for planetary work, and on this account observations were not taken on so many nights as might otherwise have been the case. Also, no night occurred on which observations could be continued far into the small hours of the morning. Either clouds would interfere or a south-easterly breeze would spring up and render the definition too bad for detail to be properly seen and delineated.

The planet at this apparition showed a great paucity of detail in the Equatorial Regions, and especially was this the case with the Bright Equatorial Zone, which was very free from markings. The North Temperate Belt No. 3 (adopting the numbers given by Mr. Stanley Williams in the Monthly Notices of the R.A.S. for April, 1891) was rendered remarkable by an outburst of small black, or very dark, spots upon it, while the South Temperate No. 6 was noticeable for the presence of two short dark belts, one of which was the darkest marking on the planet.

NORTH POLAR AND TEMPERATE REGIONS.—The North Polar Cap was usually fairly distinct. On August 5th two oval dark markings were seen at the southern edge of the cap in longitudes 105°-121° and 130°-142°, and in about longitude 32° a narrow dark belt, which had its commencement about 40° further west, joined the Polar Shading, forming its southern edge as far as longitude 58°, where it ceased to be visible as a distinctive belt. The same short belt joining with the North Polar Shading was seen again on September 10th, September 19th, and September 29th.

On August 28th and October 14th, a short dark belt was seen lying along the southern edge of the North Polar Cap, as has been noticed on former occasions.

A narrow white zone divided the Polar Shading into north and south portions on September 18th, September 21st, September 25th, October 9th, October 14th, and October 18th.

The North Temperate Belt No. 3 was double for part of its length, and at times there were three narrow belts visible south of the Polar Cap.

On August 28th the belt was split in two between longitudes 195° and 264°, and this feature was seen again on several occasions, answering to a similar duplication of the North Equatorial Belt in about the same longitudes. The belt on August 28th again became forked in longitude 315°, the northern branch having on it three round dusky spots, which were seen again on September 21st, October 7th-8th, and October 17th, though on these occasions the belt on which the spots were carried appeared to have no connection with Belt 3, but to be a distinct Belt (2) by itself. These spots had a considerable proper motion with reference to the Great Red Spot, and their movement was the more noticeable from the circumstance of their passing along north of the double part of Belt 3 and touching the northern component of that belt at its highest point.

On September 9th, at 23h. 3m. (central meridian 332°·2) Belt 3, from the preceding limb to near the central meridian, was fairly broad and presented an uneven mottled appearance, with edges slightly wavy. In about longitude 323° the mottled appearance came suddenly to an end and the belt was continued as a narrower and fainter band with straight parallel edges. In the midst of this latter part, in longitude 329°·7, was a round dark spot, differing from the black spots mentioned in the next paragraph in that it was not on the southern edge of the belt but was centrally placed, reaching from edge to edge, and was only of the same depth of shade as the darker part of the belt.

The most important feature in connection with Belt 3 in 1891 was the appearance of numerous black or very dark spots, very small in size, situated on its southern edge and usually projecting into the bright zone to the south. In appearance the spots were very minute, but they appeared to increase in size as time went on, though perhaps diminishing in depth of shade. The first night they were seen (August 5th) they were described as being absolutely black, but after that they were generally seen of a dark reddish-brown color, and were usually invisible or glimpsed only with difficulty when the definition was at all bad.

The following tables give the Transits of Spots on Belts 2 and 3 over the central meridian of the disc, observed at Adelaide, with the corresponding Jovian longitudes. The spots can easily be identified on the charts :—

Spots on North Temperate Belt No. 2.

Marking.	**G.M.T. of Central Transit.**				**Corresponding Longitude.**	**Weight. (1–5).**
	1891.	d.	h.	m.	°	
Round dusky spot	Oct.	8	8	59	247·3	—
More eastern of two dusky spots	"	8	9	26	263·6	—
Faint spot, judged to be in same longitude as a spot on Belt 3	"	17	—	—	255·0	—
Preceding end of eastern portion of belt, or following end of gap in belt	"	17	23	55	316·2	—
Minute black spot	Aug.	5	2	30	82·8	—
"	"	5	2	43	90·6	—
"	"	5	3	18	111·8	—
Minute black streak	"	5	4	29	154·7	—
Small spot, hardly so black as the others	"	5	5	16	183·1	—
A spot among several, the third from the west ..	"	24	1	6	21·7	3
Small spot	"	28	0	35	232·6	2
"	"	28	1	1	248·3	2
"	"	28	1	55	280·9	2
"	"	28	2	15	293·0	2
"	"	28	3	0	320·2	2
"	"	28	3	21	332·9	2
Small spot, observation very doubtful	Sept.	6	23	21	251·9	1
Isolated spot, not very dark, of same breadth as Belt 3	"	9	22	59	329·7	2
Small dark spots, projecting from southern edge of Belt 3 into the bright zone to the south. The spot in longitude 163° was not observed at central transit but at 4h. 21m. it was estimated to have passed the central meridian 2m. earlier	"	10	2	48	108·2	3
	"	10	2	58	114·2	3
	"	10	4	19	163·0	—
	"	10	4	30	169·8	3
	"	10	5	10	194·0	4
	"	10	5	25	203·1	3
	"	10	5	49	217·6	3

Spots on North Temperate Belt, No. 2—continued.

Marking.	G.M.T. of Central Transit.				Corre-sponding Longitude.	Weight (1–5.)
	1891.	d.	h.	m.	°	
Small spots, which, the definition being variable, stand out quite plainly at moments of best vision, but are quite invisible at other times	Sep.	15	22	32	135·7	2
	“	15	22	52	147·8	4
	“	15	23	18	163·5	3
	“	15	23	41	177·4	2
	“	16	0	14	197·4	2
	“	16	0	24	203·4	3
Small spot	“	18	1	19	177·4	2
“	“	20	0	16	80·1	3
Spot very faint, but distinctly visible at moments of good definition	“	27	21	15	93·5	3
Small spot	“	27	22	3	122·5	2
“	“	27	22	23	134·6	3
“	“	29	21	2	26·3	3
“	“	29	21	19	36·6	3
Spot, estimated at 22h. 30m. to have passed the central meridian about 3m. earlier	Oct.	7	22	27	200·0	—
A spot so small as the majority and projecting largely into the bright zone to the south	“	8	0	28	273·3	4
Spot	“	8	1	9	298·1	3
“	“	8	1	25	307·8	3
“	“	8	1	48	321·7	2
Faint spot; definition not good	“	16	23	19	144·1	2
“	“	17	22	14	255·1	3
“	“	17	23	0	282·9	2
“	“	17	23	21	295·6	4

Other spots were seen, but their transits not timed, so that their longitudes can only be taken out approximately from the drawings.

On August 5th, in addition to those given in the foregoing tables, a minute black spot was seen in longitude 134°, and a minute black streak in longitude 140°.

On August 8th the spots were not black, but dark red-brown dots or small splashes on the lighter background of the belt.

On August 24th the spots were not shown on the drawing, as cloud interfered before the sketch was finished.

On August 28th additional spots were seen in longitudes 344°, 355°, and 16°.

On September 5th very minute spots, glimpsed only at moments, were seen in longitudes 344°, 4°, 10°, and 22°.

On September 10th additional spots were seen in longitudes 245° and 266°; September 15th-16th, longitudes 100° and 110°; September 18th, longitudes 143°, 153°, 187°, 212°, and 232°; September 20th, 66°, 100°, 112°, and 129°.

On September 21st, at 0h. 41m., dark streaks and spots were seen on the southern edge of Belt 3, but their positions could not be recorded on account of cloud putting an end to observation.

On September 25th, at 22h. 30m., spots were seen, but their positions could not be fixed owing to inferior definition.

On September 27th additional spots were seen in longitudes 47°, 66°, 83°, and 115°; on September 30th, in longitude 6°; and on October 7th-8th, in longitudes 214°, 353°, and 1°.

On October 14th, at 22h. 42m., two fairly large spots were seen close to the *following* limb of the planet, projecting largely into the bright zone to the south. Their approximate positions were longitudes 221° and 241°.

On October 16th an additional spot was seen in longitude 213°, and on October 17th spots were seen in longitudes 266° and 34°.

On October 4th, at 22h. 1m. (central meridian 93°·5), the North Temperate Belt 3 exhibited a slightly different appearance to that which it usually presents. No drawing was made on account of the definition being very poor, though a few good glimpses were obtained at times. The following remarks were made that night with reference to this belt:—" About halfway from the central meridian to the preceding limb is a dark spot—rather larger than those seen here lately—on a background of light shading. *Following* this is a narrow line which appears to form the southern edge of the belt, but which comes to an end a little way *following* the aforesaid spot. The line is darkest at its end, but along the whole of its length it is darker than the interior parts of the belt. The northern edge of the belt also is fairly dark, so that from the *following* limb to near the dark spot the belt appears as one with dark edges fading off towards the central line. Preceding the end of the above-mentioned dark line the southern edge of the belt is faint and delicate."

THE NORTH EQUATORIAL BELT.—This belt was characterised in 1891 by an intense depth of shade at part of its course, being, with one exception, the darkest marking on the planet. There appeared to be two distinct layers of matter forming the belt, a dark narrow belt, having sometimes a metallic lustre, being superposed upon a broader and more lightly shaded belt. The dark narrow belt was generally straight and of uniform width, and was frequently observed to come to an abrupt and sometimes pointed end inside the more lightly shaded part, the northern edge of which was very irregular in contour.

At one part of its course, between longitudes 210° and 280° (roughly speaking), the belt appeared double, a narrow and rather faint offshoot separating itself from the belt and joining again with it a little further on, there being a similar duplication of the North Temperate Belt 3 in about the same longitudes. The northern component of the North Equatorial Belt had on it two dark oval spots, which were rather conspicuous objects. On December 1st, the last night on which observations were taken here, these spots should have been in view, but they were not seen, and the narrow faintly-shaded belt they were on had dwindled down to little more than a fine line, nor did it show signs of joining again with the dark component to the south. The definition, however, was variable and not good. A list of observed central transits of these two spots is given at the end of the remarks on this belt.

On October 18th the belt appeared broken in two, the parts being separated by a gap reaching from longitude 7° to 16°, bridged across by a fine straight line in about the middle latitude of the belt. From the northern edge of the western part of the belt, just where the gap commenced, a fine and faint streak arose, ascending northwards for a little way and then turning abruptly to the east and coming to an end in the same longitude as that in which the belt recommenced. The eastern portion of the belt also had an offshoot, but this was on its southern edge, and was simply a faint line which diverged a little from the belt itself and came to an end where the belt did, just at the *following* end of the gap.

The dark spot shown on the drawing of August 24th as being in the middle of the belt in longitude 15° was suspected at moments of clearest vision to be the end of a narrow dark belt lying along the central line of the North Equatorial Belt, but the observation was interrupted and put a stop to by clouds.

On August 28th in longitude 290°·6 a small dark spot was seen on the southern edge of the belt, connected by a zigzag bridge of shading with a somewhat similar spot on the South Equatorial Belt.

On some occasions small tufts of shading were observed starting off from the belt both to north and south, as if its edges were becoming unravelled, as for instance on September 10th, September 15th-16th, September 18th, September 27th, and October 17th-18th.

The small narrow break in the southern edge of the belt on September 27th, in longitude 112°·8, was thought at a first glance to be a small white spot, but a careful scrutiny showed that it had rather the appearance of a break in the belt itself, as if the latter had been burst through at that place and the torn edges had been slightly bent southwards. It is noteworthy also that the dark line running along the middle parts of the belt was here curved slightly to the north, skirting the edge of the small white space as if forced out of position by it.

The following tables give a list of the central meridian passages of the two dark spots on the northern component of the belt, and also of miscellaneous markings observed on the belt. The markings can easily be identified by means of the charts :—

Central Transits of Two Dark Spots on Northern Component of Belt.

FIRST SPOT.				SECOND SPOT.			
Part of Spot.	G.M.T. of Central Transit.	Corresponding Longitude.	Weight. (1-5)	Part of Spot.	G.M.T. of Central Transit.	Corresponding Longitude.	Weight. (1-5)
	1891.				1891.		
	d. h. m.	°			d. h. m.	°	
	Aug. 28 0 50	241·6	2	*Preceding* end	Aug. 28 1 8	252·5	3
	Sept. 16 1 21	237·9	2	Middle....	" 28 1 10	253·7	2
	" 21 0 26	236·5	3	*Following* end	" 28 1 12	254·9	3
	Oct. 7 23 18	231·0	4	Middle....	Sept. 6 23 24	253·7	1
	" 10 0 52	228·4	4	Middle....	" 14 0 7	252·4	4
				Middle....	" 16 1 48	254·2	3
				Following end	" 21 0 55	254·0	2
				Middle....	Oct. 7 23 45	247·3	4
				Middle....	" 17 21 55	243·6	2

Central Transits of Miscellaneous Markings on North Equatorial Belt.

Marking.	G.M.T. of Central Transit.	Corresponding Longitude.	Weight. (1-5)
	1891.		
	d. h. m.	°	
Following end of dark belt inside lighter area.....	Aug. 5 2 20	76·7	—
Dark spot in middle of belt, suspected at moments to be the end of a narrow dark belt	" 24 1 15	15·1	2
Dark spot on southern edge	" 28 2 11	290·6	2
Following end of dark belt inside lighter area.....	" 28 3 0	320·2	2
Angle of shoulder, northern edge of belt	Sept. 10 1 48	71·9	3
" " "	" 10 5 48	217·0	2
Offshoot from southern edge, at place of junction..	" 15 23 44	179·2	2
Preceding end of dark belt inside lighter area	" 25 22 7	184·3	2
Small white break in southern edge of belt	" 27 21 47	112·8	3
" " "	Oct. 4 22 19	104·4	—
Angle of shoulder, where belt becomes double	" 7 22 34	204·4	3
" " "	" 10 0 15	206·0	3

The Bright Equatorial Zone.—This zone was very free from markings, and those that were present appeared faint and indistinct. The zigzag line of shading seen on August 28th, connecting a spot on the North Equatorial Belt in longitude 290°·6 with one on the South Equatorial Belt in longitude 277°·3, should be noticed, and also the apparent outrush of matter northwards from a small dark marking connected with the South Equatorial Belt on September 10th.

A semi-circular white spot was seen on this zone on October 17th-18th, resting against the southern edge of the North Equatorial Belt, which appeared to cut it off sharply, as if the belt was at a higher level than the white spot. The spot transited the central meridian of the disc at 23h. 36m., on the 17th, answering to a longitude of 304°·7.

The South Equatorial Belt.—This belt was more broken up than its northern colleague, but it did not show a great variety of detail. As usual, a common feature was the presence of short dark belts, either overlying the more faintly shaded continuous belt or separated from it by narrow white spaces.

The small curved dark markings adjoining the northern edge of the belt on August 5th and September 10th are rather unusual.

Round dark spots were seen immersed in the belt on August 28th, September 19th, and October 7th-8th. The dark pear-shaped spot shown in the drawing for October 17th-18th, in longitude 313°·7, was very conspicuous, and extended both north and south from the belt, which there became very narrow. The general appearance of the belt on that night was rather unusual, not only with regard to its contour but also the sudden transitions from darker to lighter shades.

The following table gives the observed central transits of miscellaneous markings on the South Equatorial Belt in 1891. The markings can easily be identified by means of the charts :—

Central Transits of Miscellaneous Markings on South Equatorial Belt.

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight. (1–5)
	1891.	d.	h.	m.	°	
Angle of shoulder on southern edge, *following* the Great Red Spot	July	21	3	5	8·2	—
" " "	Aug.	5	0	37	14·5	—
" " "	Sept.	5	1	1	11·5	2
" " "	"	10	0	10	12·7	2
Preceding end of short curved belt adjoining northern edge	Aug.	5	2	18	75·5	—
Following end of dark belt on northern edge	"	5	4	11	143·8	—
Thickest part of dark belt next *following* the above	"	5	4	29	154·7	—
Festoon-pillar	"	28	0	33	231·3	3
Dark roundish spot	"	28	1	49	277·3	3
Small conical pillar of shading rising from northern edge	"	28	3	19	331·7	2
Following end of the second of two small curved markings adjoining northern edge	Sept.	10	2	36	100·9	2
Faint line of shading rising from northern edge	"	10	3	24	129·9	2
The more eastern of two conspicuous projections from northern edge	"	10	5	31	206·7	3
Following end of northern dark portion of belt	"	15	23	52	184·1	2
Preceding end of dark belt *following* the above	"	16	0	6	192·5	2
Preceding end of dark belt on *following* side of gap in northern component	"	18	1	13	173·8	3

Central Transits of Miscellaneous Markings on South Equatorial Belt.—continued.

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight (1–5)
	1891.	d.	h	m.	°	
Middle of swelling at *following* end of short dark belt lying along northern edge	Sept.	25	22	7	184·3	2
Preceding end of short dark belt *following* the above	"	25	22	30	198·2	2
Short pillar of shading rising from northern edge..	"	27	21	25	99·5	3
Conical projection forming base of festoon-pillar ..	"	27	21	57	118·9	3
Preceding end of short dark belt on northern edge.	"	29	21	23	39·0	3
Following end of short dark belt on northern edge.	"	29	22	2	62·6	2
Dark swelling on northern edge	"	29	22	38	84·3	2
Preceding end of short dark belt	Oct.	7	21	44	174·2	3
Following end of short dark belt	"	7	22	13	191·7	2
Round dark spot inside northern component	"	7	23	45	247·3	4
Festoon-pillar rising from protuberance on northern edge	"	14	21	45	146·8	2
Following end of dark belt along northern edge ...	"	14	23	5	195·1	2
Dark pear-shaped spot, projecting both to north and south of belt	"	17	23	51	313·7	4

THE GREAT RED SPOT.—The Great Red Spot was seen on 11 nights, and was very plainly visible. It usually presented the appearance of a ring, but on three nights (September 19th, October 8th, and October 18th), the edge was no darker than the interior. Appended are the remarks made on each night when the Spot was seen :—

1891, July 21st, 3h.—" The Great Red Spot appeared of a peculiar shape, both at mid-transit and afterwards, as well as could be seen with bad definition." (A rough sketch was made, showing the Spot's southern edge bent in, as shown also in the drawing of 1888, June 15th. A narrow belt is shown joining with the southern edge of the Spot, following its contour, and continuing straight on after leaving the Spot's south-following edge. The definition was too bad for a complete drawing to be made.)

1891, August 5th, 0h. 41m.—" The Great Red Spot is in view, and appears of a decided pink color. It appears to be joined at its *following* end to a belt in about the same latitude as the southern edge of the Spot."

1891, August 19th, 1h. 16m.—" Great Red Spot in view, but the planet can only be glimpsed for a few seconds together, owing to clouds. There is a round white spot touching the southern edge of the Great Red Spot, about midway along it, and this appears to cause the south boundary of the latter to be curved inwards, but this may have been only an effect of contrast, the planet only being visible occasionally, and the definition not being good enough to permit of any certainty about it. The Great Red Spot has a distinct ring appearance, the edge all round being darker than the interior, and the southern edge is also plainly darker than the northern edge."

1891, August 24th, 1h. 15m.—" Whenever the planet was free from cloud, attention was specially directed to the Great Red Spot. At a first glance the Spot appeared as noted on August 19th, there being a round white spot just south of it, at the middle of its southern edge, but at moments of best vision it appeared as shown in sketch [see chart], the Red Spot having its outline the same as usual, while the bent-in appearance is really owing to the dark belt *following* the Spot being bent northwards so as to curve round the white spot. Whether the dark belt joined the Red Spot could not be determined, the planet only being free from cloud for a few moments at any one time, but it was suspected once or twice that there was a very narrow white streak separating the belt from the Red Spot, all along the southern edge of the latter."

1891, August 28th, 3h. 9m.—" The Great Red Spot, near the following limb, was described as ' having a decided pinkish tinge'."

1891, September 5th, 0h. 35m.—" The Great Red Spot is near the central meridian, and appears somewhat more elongated than usual. At times there appears to be a brilliant white spot south of the preceding end of the Great Red Spot, but the brilliancy is evidently more or less an effect of contrast, the marking being resolved, when the definition is at its best, into a white cloud surrounded by darker shading, as shown in the drawing [see chart], the cloud losing then its brilliant aspect. It is very difficult to make out whether the dark belt following the Great Red Spot actually touches it or not. The general impression is, however, that it just touches but does not overlap the Spot. At times it is suspected that there is a narrow white line dividing the Spot from the belt, but this cannot be made out with certainty, and may have been due to fatigue of the eye."

1891, September 9th, 23h. 51m.—" The dark belt following the Great Red Spot appears to join with it. It rather gives one the impression that the Great Red Spot is at a higher level than the belt, and actually overlaps it, but this of course may be only an effect of the imagination."

1891, September 19th, 21h. 40m.—" The Great Red Spot is well in view, but its outline appears indistinct, and it appears to have lost the ring appearance it usually presents." However, in the drawing made at 22h. 51m., the edge of the Spot is shown slightly darker than the interior.

1891, September 29th, 21h. 8m.—" The Great Red Spot is very plain indeed to-night, and seems to be getting decidedly darker. It also seems to be rather larger than usual."

1891, October 8th, 2h. 16m.—" With regard to the Great Red Spot, several things required to be noticed :—(*a*) Its color : this is to-night a decided pink, the contrast being very noticeable between the color of the Spot and that of the short dark belt joining on to its *south-preceding* side. (*b*) Its shape : apparently symmetrical, roughly oval, pointed at both ends. (*c*) Its shading and general appearance : no appearance of a ring, but the Spot fades off a little at the edges, which are somewhat lighter than the interior, otherwise it is of uniform shade all over. (*d*) Its relative height : though this of course is uncertain, still the Spot certainly presents an appearance as if it lay at a greater height than the belts which apparently join it on either side. In the first place the Spot is complete in itself, and its outline is not interfered with by the belts joining it, nor can they be seen overlying the Spot, nor yet through or underlying it. In the second place the belts on either side of the Spot are in the same line with one another and might, so far as appearance goes, be parts of one and the same belt, though certainly the belt preceding the Spot is very much darker than the one following it. Moreover the ends of these belts exactly fit the Spot, as if its edges cut the belts off."

1891, October 18th, 1h. 4m.—" The Great Red Spot is now a little way past central transit, and its northern edge appears rather flatter than usual. It does not present the aspect of a ring to-night, but the *following* end is perhaps a very little darker than the rest of the Spot. The belts which meet the Spot on either side are seen to-night to be pushed away to the south, being, both of them, almost tangential to the Spot's edge. Both belts appear somewhat curved, as if pushed away by the repellant power of the Great Red Spot. At moments it is suspected that the belts do not quite touch the Spot, but the unsteadiness of the definition prevents it being anything more than a suspicion."

The following table gives the central transits of the Great Red Spot observed in 1891 :—

Central Transits of the Great Red Spot.

Part of Spot.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight. (1-5)
	1891.	d.	h.	m.	°	
Middle of spot	Aug.	5	0	1	352·7	—
Following end	"	5	0	24	6·6	—
Preceding end	"	19	1	19	345·5	—
Following end	Sept.	5	0	59	10·3	3
Preceding end	"	19	21	44	348·2	2
" "	Oct.	8	2	16	338·6	4
" "	"	18	0	30	337·3	3
Following end	"	18	1	21	8·1	4
Preceding end	Dec.	9	23	32	340·6	1

On August 24th, at 1h. 3m., the *following* end of the Great Red Spot was judged to have passed the central meridian only one minute before, or at 1h. 2m., answering to a longitude of 8°·2.

SOUTH TEMPERATE AND POLAR REGIONS.—These parts of the planet showed several interesting features. Two short dark belts in the latitude of Belt 6 were conspicuous objects, and a few white spots were also seen.

The first of the two short dark belts, in order of longitude, was the darkest marking on the planet, being darker even than the North Equatorial Belt, though on some occasions it was difficult to say which of the two had the greater depth of shade. The belt extended over nearly 20° of longitude, and had straight parallel sides and straight cut ends also, so that, as seen here, it hardly seemed to merit the name of " elliptical spot " given to it by English observers. When viewed under the most favorable atmospheric conditions the belt appeared extremely narrow from north to south, and was very sharply defined, with no fading away at the edges. It was seen also to be just a little further to the south than the northern edge of Belt 6, and was bounded along its southern edge by a narrow white belt. On September 10th and September 27th, a round white spot was seen at its south-preceding corner.

The second of the short dark belts was situated a little west of the Great Red Spot and, like the first one, was a little further south than the northern edge of Belt 6. Although not nearly so dark as the first-mentioned belt, this one was always a conspicuous object and was considerably longer than the other. From August 28th to September 19th only one short belt intervened between this second dark belt and the Great Red Spot, but on October 8th another belt had made its appearance, and when the dark belt was nearing the preceding limb there were three short belts ranged across the disc in this latitude, the Great Red Spot being on the *following* limb.

On September 30th and subsequent occasions a short narrow dark belt was seen following the first of the above-mentioned belts. On October 14th its preceding end crossed the central meridian at 21h. 45m., and its following end at 22h. 22m., answering to longitudes of 146°·8 and 169°·1 respectively.

A curious feature was observed on September 27th in the shape of a fair-sized oval spot, of a dusky shade, lying obliquely on the broad band of shading to the south of Belt 6, and almost touching the following end of the first of the short dark belts just mentioned. There appeared to be traces of another oval spot just faintly visible following the first one and joined on to it, but lying parallel to the Equator and not obliquely situated.

The first of these oval spots was seen again on September 30th, but it had altered in appearance and was then lying with its longer axis parallel to the belts. On October 15th it was seen again, fairly distinct, together with two small dark spots preceding it, a similar dark spot being situated just inside the preceding end of the oval [see chart].

On October 18th when the Great Red Spot was near the central parts of the disc, the two belts on either side (as noted in the Remarks on the Great Red Spot) were apparently thrust out of position, and bent so as to skirt the southern edge of the Spot. The adjoining ends of the belt, south of the Spot, were very close together, and at moments of unfavorable definition it appeared as if there was a small white spot in that position, but at times of clearer vision the spot resolved itself into the white space separating the adjoining ends of the two belts.

On August 28th a small dark spot was observed near the preceding limb, situated between Belt 6 and the shading to the south, reaching from one to the other. This was seen again on September 10th, when it transited the central meridian at 5h. 34m., answering to a longitude of 208°·5, and on several subsequent occasions. On October 14th it was found to have a companion spot, distant from itself 8°·4 of longitude. On December 1st, when this part of the planet was again favorably situated, neither of these spots was seen, but the definition was variable and not good.

White spots were seen in South Temperate latitudes on several occasions, and two of these spots appeared to be intimately associated with dark shading, which seemed either to owe its origin to the spot or to be an effect of the same cause that produced the spot.

The drawing of September 29th should be noticed on account of the way in which Belt 6 curves southwards round the northern and eastern edges of a round white spot in longitude 46°, and for the way also, in which the South Polar Shading curves northwards from each side to meet the same spot. A repetition of this feature may be found in the drawing for October 18th.

On August 19th and 24th, a round white spot was seen touching the southern edge of the Great Red Spot, at about the middle of it.

The following table gives the observed Central Transits of the two short dark belts and other markings in South Temperate Latitudes in 1891. The markings can easily be identified by means of the charts :—

Central Transits of Short and Very Dark Belt.

Part of Belt.	G.M.T. of Central Transit.				Corre-sponding Longitude.	Weight (1-5).
	1891.	d.	h.	m.	°	
Preceding end	Aug.	5	4	19	148·7	—
Following end	“	5	4	56	171·0	—
Preceding end	“	8	1	46	147·4	—
“ “	Sept.	10	3	26	131·1	3
Following end	“	10	3	58	150·5	3
Preceding end	“	15	22	26	132·1	3
Following end	“	15	22	55	149·6	3
Preceding end	“	27	22	9	126·1	2
Following end	“	27	22	38	143·6	3
“ “	Oct.	14	21	25	134·7	3

Central Transits of Short Dark Belt Preceding the Great Red Spot.

Part of Belt.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight (1-5).
	1891	d.	h.	m.	°	
Following end	Aug.	26	1	18	315·5	—
Preceding end	"	28	1	59	283·3	2
Following end	"	28	3	0	320·2	2
Preceding end	Sept.	7	0	1	276·0	2
Following end	"	7	0	52	306·9	2
Preceding end	"	26	0	18	263·4	2
Following end	Oct.	8	0	55	289·6	4
Preceding end	"	17	22	13	254·5	2
Following end	"	17	23	13	290·8	3

On October 8th, at 0h. 8m., the Short Dark Belt preceding the Great Red Spot was estimated to have passed the central meridian with its preceding end about four minutes earlier, answering to a longitude of 259°.

Central Transits of White Spots in South Temperate Regions.

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight (1-5).
	1891	d.	h.	m.	°	
White spot	Aug.	5	2	21	77·3	—
"	"	5	3	16	110·6	—
White spot, more western of two	"	24	1	21	18·7	—
White spot	Sept.	10	1	21	55·6	3
"	"	19	23	31	52·9	3
"	"	20	0	30	88·5	2
"	Oct.	13	22	46	33·4	3

On August 5th a white spot was estimated, shortly after passage, to have crossed the central meridian at 1h. 39m., answering to a longitude of 52°, and on September 29th, at 21h. 39m., a white spot was estimated as having crossed the central meridian four minutes previously, or at 21h. 35m., answering to a longitude of 46°

Central Transits of Miscellaneous Spots in South Temperate Regions.

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight (1-5)
	1891.	d.	h.	m.	°	
Small dark spot on southern edge of Belt 6	Sept.	10	5	34	208·5	3
" " "	"	16	0	40	223·1	2
" " "	Oct.	7	22	31	202·6	3
" " "	"	14	23	7	196·3	3
Faint dusky spot, a little west of the above	"	14	22	53	187·9	1
Short belt in latitude of Belt 6—						
Preceding end	"	14	21	45	146·8	2
Following end	"	14	22	22	169·1	2

The observation of central transit of the small dark spot on southern edge of Belt 6 on September 16th seems to be several minutes in error. The definition was very variable, which may perhaps partly account for it.

This same spot was seen also on September 25th, when it was estimated at 22h. 47m. to have passed the central meridian two minutes before, answering to a longitude of 207°.

The following measures of Latitudes of the Belts were taken during 1891, but owing to the unfavorable atmospheric conditions and the erratic going of the driving clock, they are not so reliable as might otherwise have been the case. With regard to the disagreements between the individual measures it may be noted that the belts did not always appear to run straight across the disc parallel to the Equator, but frequently appeared slightly tilted one way or the other, and the South Equatorial Belt was so irregular that measures of it at different parts of its course could hardly be expected to agree well together.

Measure of Latitude of North Polar Cap.

Date.	Approximate Central Meridian.	Marking.	Distance from Centre in Terms of Polar Radius.	Corresponding Latitude.	Elevation of Earth above Jupiter's Equator.	True Latitude.	No. of Measures.	Weight (1-5).
1891. d. h. m.	°			°	°	°		
Oct. 17 22 39	270	Southern edge.	+ ·61	+ 35·82	+ 1·51	+ 37·33	6	3

Measure of Latitude of North Temperate Belt No. 2.

Oct. 8 2 1	330	Middle of belt.	+ ·52	+ 29·71	+ 1·56	+ 31·27	6	4

Measures of Latitude of North Temperate Belt No. 3.

Sep. 5 1 46	39	Middle of belt	·38	+ 21·06	+ 1·73	+ 22·79	—	—
" 10 5 ±	190	" "	·36	+ 19·89	+ 1·71	+ 21·60	—	—
" 10 5 ±	190	South edge of belt	·33	+ 18·15	+ 1·71	+ 19·86	—	—
" 15 23 ±	155	South edge of belt	·29	+ 15·86	+ 1·68	+ 17·54	4	good
Oct 8 0 ±	257	South edge of belt	·32	+ 17·57	+ 1·56	+ 19·13	5	4
" 17 22 46	274	South edge of belt	·30	+ 16·43	+ 1·51	+ 17·94	6	3

Measures of Latitude of North Equatorial Belt.

Sep. 5 1 46	39	Middle of belt	·10	+ 5·38	+ 1·73	+ 7·11	—	—
" 10 5 ±	190	" "	·09	+ 4·84	+ 1·71	+ 6·55	2	–
" 29 22 51	92	" "	·14	+ 7·55	+ 1·60	+ 9·15	6	—
Oct. 17 23 ±	280	Middle of south dark portion, just preceding the place where belt bends slightly to north	·12	+ 6·46	+ 1·51	+ 7·97	6	3
" 8 0 ±	254	Dark spots on northern component, where belt is double.	·22	+ 11·94	+ 1·56	+ 13·50	6	4

Measures of Latitude of South Equatorial Belt.

Date.	Approximate Central Meridian.	Marking.	Distance from Centre in Terms of Polar Radius.	Corresponding Latitude.	Elevation of Earth above Jupiter's Equator.	True Latitude.	No. of Measures.	Weight. (1-5)
1891. d. h. m.	°			°	°	°		
Oct. 10 5 ±	39	North edge	·21	− 11·39	+ 1·73	− 9·66	—	—
Sept. 5 1 46	190	" "	·16	− 8·64	+ 1·71	− 6·93	—	—
" 29 21 31	44	" "	·12	− 6·46	+ 1·60	− 4·86	6	—
Oct. 7 22 26	200	" "	·17	− 9·19	+ 1·56	− 7·63	3	1
Sept. 5 1 46	39	South edge	·30	− 16·43	+ 1·73	− 14·70	—	—
" 10 5 ±	190	" "	·31	− 17·00	+ 1·71	− 15·29	—	—
" 29 21 41	50	" "	·30	− 16·43	+ 1·60	− 14·13	6	—
Oct. 8 23 13	228	" "	·34	− 18·72	+ 1·56	− 17·16	6	3
" 17 23 44	310	Narrow part of belt where it crosses pear-shaped spot	·21	− 11·39	+ 1·51	− 9·88	3	2

Measure of Latitude of Great Red Spot.

Oct. 18 1 26	11	Middle line	·40	− 22·25	+ 1·51	− 20·74	6	1
" 18 1 41	20	South edge	·51	− 29·07	+ 1·51	− 27·56	4	1

Measure of Latitude of Short and Very Dark Belt in South Temperate Regions

Sept. 10 4 1	152	Short dark belt	·48	− 27·16	+ 1·71	− 25·45	5	—
" 15 23 1	155	" "	·49	− 27·79	+ 1·68	− 26·11	4	good
" 27 22 51	151	" "	·47	− 26·53	+ 1·62	− 24·91	6	—

Measures of Latitude of Short Dark Belt Preceding the Great Red Spot.

Oct. 8 0 46	284	Short dark belt	·47	− 26·53	+ 1·56	− 24·97	6	4
" 17 23 3	285	" "	·51	− 29·07	+ 1·51	− 27·56	6	4

Measure of Latitude of White Spot in South Temperate Regions.

Sept. 29 21 56	59	White spot	·50	− 28·42	+ 1·60	− 26·82	4	–

REMARKS, 1892-93.

Eight drawings were obtained on five nights during this apparition.

The chief belts of the planet presented a much more regular appearance than they had done of late years, and again the Bright Equatorial Zone was very free from markings.

The North Polar and Temperate Regions.—The North Polar Cap was generally rather indistinct, but this may have been partly due to the variable definition, which was not constantly good on any of the nights of observation. This was the more to be regretted, as the Polar Cap had on it some curious dark shadings on December the 18th and 20th, the forms of which could not be made out with any certainty, though they appeared on the whole as shown on the chart.

On December 20th there appeared to be a small dark isolated spot, having its following end in longitude 92°·9, situated near the southern edge of the Polar Cap and only prevented from forming a junction with it by the northward curve of the Cap's southern boundary. The Polar Cap appeared, on the same evening, to join with the North Temperate Belt 3 at two points, in longitudes 56°·0 and 79°, and near the points of junction the Cap was more darkly shaded [see charts].

The North Temperate Belt was very dark along part of its course. On December 15th, at 22h. 27m., it was described as " almost rivalling the North Equatorial Belt," and on December 19th, at 1h. 13m., it was found to be the darkest marking visible on the disc, slightly darker than the North Equatorial Belt.

On December 18th, at 22h. 56m., the belt west of longitude 121°·8 was rather faint, but in that position a well-defined dark belt commenced, taking the place of the fainter one and appearing to overlap it [see chart]. The fainter belt forked into two in about longitude 97°, but the northern branch only continued for a short distance, coming to an end in about longitude 130°. In that longitude, but a little further to the north, another belt, faint and very narrow, commenced, running along parallel to Belt 3 and reaching from limb to limb when the longitude of the central meridian was 200°·3. This forking of Belt 3 was noticed again on December 20th, at 23h. 40m. On this night there was a small triangular protuberance from the southern edge of the belt in longitude 69°·9, with a tiny black spot at its extremity.

The North Equatorial Belt.—This belt was narrow and dark, and showed none of the structural details noticed in former years.

Three small dark spots were seen immersed in the belt on January 8th, at 22h. 26m., in approximate longitudes 337°, 351°, and 3°. The middle spot of the three was just inside the northern edge of the belt, while the other two were on the belt's southern edge [see chart].

The Bright Equatorial Zone.—This zone was very free from markings, only a few scattered whisps of shading projecting into it from the South Equatorial Belt.

The South Equatorial Belt.—This belt also showed very little structural detail. On December 19th, at 1h. 13m., a round dark spot, terminating a portion of the northern component of the belt, was seen at mid-transit, answering to a longitude of 200°·3.

The Great Red Spot.—This Spot was seen on three occasions, December 15th, December 20th, and January 8th, and the following remarks were made concerning it :—

December 15th, 22h. 27m.—" The *following* end of the Great Red Spot is on the central meridian, answering to a longitude of 7°·0, while its *preceding* end can scarcely be seen at all. The Spot is very faint, though its *following* end, which is sharply pointed, is fairly distinct. A narrow dark belt meets with the Spot along the southern edge of the latter, the belt being bent to the south and following the contour of the Spot till it leaves the latter in the same latitude that it joined with it. The portion touching the Spot is darker than the rest ; indeed, it is not at all certain that this darker portion is not a shading belonging to the Spot itself and overlying the belt."

December 20th, 22h. 45m.—" The *following* end of the Great Red Spot is visible close to the preceding limb, and a little earlier in the evening it was fairly distinct."

January 8th, 22h. 26m.—" The Great Red Spot is visible, but its *preceding* end can scarcely be seen, though it is thought at times that the complete oval can be made out. The southern edge of the Spot seems to be mixed up with the South Temperate Belt No. 6, which is there darker than usual."

The South Temperate and Polar Regions.—There was very little detail visible in these regions, the most notable features being some oval white spots seen on December 18th, December 20th, and January 8th. Those observed on December 18th were rather larger than the usual spots seen in these latitudes, but the spot seen on January 8th was very small and indistinct.

The South Polar Cap was generally fairly plain, but on December 15th, at 22h. 27m.. it was noted to be faint.

The following observations of transits of markings over the central meridian of the disc were taken during 1892-93. The markings can easily be identified by means of the charts :—

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.	Weight. (1-5)
	1892–93.	d.	h.	m.	°	
NORTH TEMPERATE BELT NO. 3—						
Preceding end of narrow dark belt	Dec.	18	23	3	121·8	2
Small triangular protuberance on northern edge ..	“	20	22	53	56·0	1
Small black spot on southern edge	“	20	23	16	69·9	2
Isolated dark spot to north of Belt 3 ; thickest part at *following* end of spot	“	20	23	54	92·9	1
NORTH EQUATORIAL BELT—						
Angle on northern edge, at junction of two apparently different belts	“	5	0	6	217·3	—
SOUTH EQUATORIAL BELT—						
Projection on northern edge	“	5	0	1	214·3	—
Round dark spot on northern edge	“	19	1	13	200·3	3
Angle of shoulder on southern edge, *following* the Great Red Spot	“	15	22	34	11·2	—
Angle of shoulder on southern edge, *following* the Great Read Spot	Jan.	8	22	35	17·3	2
THE GREAT RED SPOT—						
Following end	Dec.	15	22	27	7·0	—
“	Jan.	8	22	26	11·9	2
SOUTH TEMPERATE BELT—						
White spot, middle one of three	Dec.	18	22	37	106·1	2
White spot, most easterly of three	“	18	23	6	123·6	3
Oval white spot	“	20	22	34	44·5	3
“ “	“	20	23	40	84·4	2
“ “	“	21	0	10	102·5	2

On December 20th, at 23h. 2m., a protuberance on the northern edge of the South Equatorial Belt was estimated to have passed the central meridian two minutes before, or at 23h. 0m., answering to a longitude of 60°.

The following measures of latitudes of the belts were made on the 18th-19th of December, 1892, and the 9th January, 1893 :—

Measures of Latitude of North Temperate Belt No. 3.

Date.	Approximate Central Meridian.	Marking.	Distance from Centre in Terms of Polar Radius.	Corresponding Latitude.	Elevation of Earth above Jupiter's Equator.	True Latitude.	No. of Measures.	Weight. (1-5)
1892-93. d. h. m.	°			°	°	°		
Dec. 18 23 36	142	Dark portion of belt	+ 0·38	+ 21·06	+ 2·71	+ 23·77	5	2
Jan. 9 22 41	171	Belt 3	0·35	+ 19·30	+ 2·64	+ 21·94	10	2
Measures of Latitude of North Equatorial Belt.								
Dec. 19 0 6	160	—	+ ·08	+ 4·30	+ 2·71	+ 7·01	5	2
Jan. 9 22 56	180	—	·09	+ 4·84	+ 2·64	+ 7·48	10	2
Measures of Latitude of South Equatorial Belt.								
Jan. 9 23 6	186	North edge	— ·18	— 9·73	+ 2·64	+ 7·09	10	1
Dec. 19 0 21	169	Middle	— ·25	— 13·61	+ 2·71	— 10·90	10	1
Jan. 9 23 31	201	South edge	— ·32	— 17·57	+ 2·64	— 14·93	10	1

REMARKS, 1893.

At the apparition of 1893-94 only eight drawings were taken on three nights.

The main belts showed more detail than during the last opposition, but the amount was still very small, and the Bright Equatorial Zone was again very free from markings.

The North Polar Cap was generally very faint, but the North Temperate Belt 3 was the darkest marking on the disc. On all of the three nights of observation it was perfectly uniform and straight, with parallel edges.

The North Equatorial Belt was difficult to make out satisfactorily, the definition being very variable each night.

On October 24th, at 4h. 5m., it was described as having a peculiar cloud-like appearance, with nothing sharp and definite about it as about the other belts.

Between this belt and the North Temperate Belt 3 a white spot was seen on December 8th, in longitude 179°·7, preceded by a dusky shading reaching from longitude 169°·4 to the Spot's western edge in longitude 177°·2. The shading was seen again on December 11th, at 0h. 36m., but the white spot was not noticed.

The Bright Equatorial Zone was almost entirely free from markings.

The South Equatorial Belt was fairly broad and dark, but showed little detail.

In South Temperate Regions some white spots were seen on October 24th, but not on the other two nights of observation.

The South Polar Shading was fairly distinct.

The following observations of the transits of markings over the central meridian of the disc were made during the 1893-94 apparition. The markings can easily be identified by means of the charts :—

Marking.	G.M.T. of Central Transit.				Corresponding Longitude.
	1893.	d.	h.	m.	°
North Equatorial Belt—					
Preceding end of short dark belt	Oct.	24	2	46	208·8
Following end of short dark belt	"	24	3	16	226·9
Preceding end of narrow dark belt	Dec.	10	23	24	105·2
Following end of narrow dark band lying transversely across belt	"	11	0	14	135·5
Preceding end of dusky shading north of belt	"	8	23	32	169·4
White spot adjoining the above dusky shading—					
Preceding edge	"	8	23	45	177·2
Middle	"	8	23	49	179·7
Following edge	"	8	23	54	182·7
South Equatorial Belt—					
Preceding end of dark belt on northern edge	Oct.	24	2	6	184·6
Following end of dark belt on northern edge	"	24	3	17	227·5
Preceding end of a second dark belt	"	24	3	25	232·3
South Temperate Belt No. 6—					
White spot	Oct.	24	4	1	254·1
White spot	"	24	4	29	271·0
Following end of dark belt	Dec.	8	23	35	171·2
Preceding end of dark belt	"	10	23	29	108·3
Following end of dark belt (doubtful)	"	11	1	0	163·3

On December 11th, at 0h. 14m., a semi-circular hollow in the northern edge of the South Equatorial Belt was estimated to have been centrally placed three minutes earlier, answering to a longitude of 134°.

NOTE.—From the recorded times of transit of the Great Red Spot and other markings across the central meridian of the disc the values given in Table A for the rotation periods in the corresponding latitudes of Jupiter have been obtained. The differences in the values for the Great Red Spot may be due partly to the difficulty of getting an exact determination of the time of transit, and possibly also to actual changes on the surface of Jupiter.

A good average value of the rotation period of the Great Red Spot during these years has also been obtained by measuring its position on the original drawings, some of which are not included in the charts prepared for publication by Mr. Sells. As explained in the Introduction, one or two of the most distinctive features were first sketched in their proper position corresponding to some definite time of observation, and the remainder of the detail was then carefully drawn in true relative position. The distance of the centre of the Great Red Spot from the centre of the disc has therefore been measured, and a value of the rotation period derived, as shown in Tables B and C.

G. F. D.

TABLE A.

Rotation Period of Jupiter calculated from observations of transits of the different markings across Central Meridian of disc.

Year.	Marking.	Dates of Observation.	No. of Rotations.	Rotation Period. h. m. s.
1884	Small dusky spot in about same Latitude as Red Spot	March 20 to April 6	41	9 55 7
1885	Small dusky spot in Equatorial region	March 18 to March 23	12	9 50 30
1886	Great Red Spot (Following end) .	February 3 to April 11	162	9 55 37
1889	Hollow Ring (about same Latitude as Red Spot)	June 24 to July 2	21	9 55 34 approx.
1891	First Dark Spot (about same Latitude north as Red Spot is south)	August 28 to October 7	99	9 55 26
	Second Dark Spot in same Latitude as above	August 28 to October 7	99	9 55 30
	Great Red Spot (Following end)	August 5 to October 18	179	9 55 38
1892–3	" "	December 15 to January 8	58	9 55 49

TABLE B.

Period of Rotation of Jupiter calculated from measurements on the original drawings of the centre of the Great Red Spot from the Central Meridian of the disc, taking the first and last drawings of each set.

Dates of Drawings.	G.M.T. h.	G.M.T. m.	No. of Rotations During Interval.	Rotation Period. h.	m.	s.	Extreme Limit of Error Probably Not Greater than s.
1885—February 16th	12	32·5	1,065	9	55	36·7	± 1·8
1886—May 3rd	0	38·5					
1886—May 3rd	0	38·5	1,871	9	55	43·0	± 1·0
1888—June 15th	1	4·5					
1888—June 15th	1	4·5	1,073	9	55	42·9	± 1·8
1889—September 1st	22	26·5					
1889—September 1st	22	26·5	1,697	9	55	44·6	± 1·1
1891—August 5th	0	4·0					
1891—August 5th	0	4·0	1,264	9	55	42·8	± 1·5
1893—January 8th	21	46·5					

Taking the whole series in one interval, 1885, February 16th, to 1893, January 8th (*i.e.*, nearly nine years) we get for 6,970 rotations an average rotation of 9h. 55m. 42·4s.

In order to eliminate as far as possible the errors of individual drawings, values were also obtained by combining each drawing of one opposition with all the drawings in turn of the following opposition and taking the mean of the values so obtained. The results are shown in the following table, which gives, perhaps, the most accurate results for the periods specified :--

TABLE C.

Mean of Combined Drawings.

Interval.		Mean Rotation Period. h.	m.	s.
1885–1886	=	9	55	35·83
1886–1888	=	9	55	42·83
1888–1889	=	9	55	43·78
1889–1891	=	9	55	43·89
1891–1892–3	=	9	55	43·35
Mean of the whole set		9	55	41·94

APPENDIX I.

OBSERVATIONS OF THE ECLIPSES, OCCULTATIONS, AND TRANSITS OF JUPITER'S SATELLITES, MADE WITH THE 8IN. COOKE EQUATORIAL DURING THE YEARS 1876 TO 1889, 1891 TO 1894 AND 1902 TO 1905, INCLUSIVE.

The observers during these years were—

Sir Charles Todd (T.)
Mr. A. Ringwood (R.)
Mr. W. E. Cooke (C.)
Mr. E. P. Sells (S.)
Mr. R. F. Griffiths (G.)
Mr. G. F. Dodwell (D.)
Mr. E. Bromley (B.)

Observations for time were obtained with a 5in. Transit Instrument from 1876 to 1884, and after that year with the 6in. Troughton & Simms Transit Circle Telescope.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observations of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. East. || **LATITUDE, 34° 55′ 38·5″ South.**

1876.

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
		1876.				h m s	h m s	h m s	m s	
1	T	June 13	I.	Oc. D.	External contact	6 21 9·50	21 6 49·20	21 14	—	200
2					Bisected	6 23 4·50	21 8 44·20	—	—	"
3					Internal contact	6 27 32·00	21 13 11·70	—	—	"
4	T	June 22	I.	Ec. R.	First seen	5 37 39·35	20 23 19·05	20 23 30·4	+ 0 11	"
5	T	June 23	III.	Ec. R.	First seen	6 24 43·80	21 10 23·50	21 14 5·9	+ 3 42	"
6	T	June 25	II.	Ec. R.	First seen	12 54 45·80	3 40 25·50	3 43 11·2	+ 2 46	"
7	T	June 28	I.	Tr. I.	External contact	7 9 22·10	21 55 1·80	21 55	—	"
8					Bisected	7 11 30·10	21 57 9·80	—	—	"
9					Internal contact	7 13 10·10	21 58 57·80	—	—	"
10	T	"	I.	Tr. E.	Internal contact	9 15 51·94	0 1 31·64	0 8	—	"
11					Bisected	9 18 26·94	0 4 6·64	—	—	"
12					External contact	8 20 20·43	0 6 0·13	—	—	"

13	T	“	I.	Sh. E.	Internal contact	10 10 33·36	0 56 13·06	1 2		—	“
14					Limb indented	10 12 24·86	0 53 4·56	—		—	“
15					Limb complete	10 13 23·86	0 59 3·56	—		—	“
16	T	June 29	I.	Ec. R.	First seen	7 32 27·12	22 18 6·85	22 18	1·8	−0 5	“
17	T	July 4	II.	Tr. I.	External contact	6 1 8·88	20 46 48·58	20 45		—	“
18					Bisected	6 2 58·38	20 48 38·08	—		—	“
19					Internal contact	6 5 37·88	20 51 17·58	—		—	“
20	T	“	II.	Sh. I.	First seen	8 0 10·68	22 45 50·38	22 44		—	“
21					Shadow bisected (?)	8 1 30·68	22 47 10·38	—		—	“
22					Internal contact	8 3 59·38	22 49 39·08	—		—	“
23	T	“	II.	Tr. E.	Internal contact	8 29 16·63	23 14 56·33	23 19		—	“
24					Satellite bisected (?)	8 31 33·13	23 17 12·83	—		—	“
25					External contact	8 33 37·63	23 18 17·33	—		—	“
26	T	“	II.	Sh. E.	Internal contact	10 24 51·14	1 10 30·84	1 20		—	“
27					Limb indented	10 26 40·94	1 12 20·64	—		—	“
28					Limb complete	10 28 57·14	1 14 36·84	—		—	“
29	T	July 5	I.	Tr. I.	External contact	8 56 24·00	23 42 3·70	23 44		—	“
30					Bisection (?)	8 58 33·80	23 44 13·50	—		—	“
31					Internal contact	9 0 28·50	23 46 8·20	—		—	“
32	T	“	I.	Sh. I.	First seen	9 57 12·40	0 42 52·10	0 44		—	“
33					Limb indented	9 58 43·90	0 44 23·60	—		—	“
34					Internal contact	10 1 6·10	0 46 45·80	—		—	“
35	R	July 7	I.	Sh. E.	Internal contact	6 34 23·93	21 20 3·63	21 26		—	“
36					Bisection (?)	6 35 51·43	21 21 31·13	—		—	“
37					Limb complete	6 37 26·43	21 23 6·13	—		—	“
38	T	July 12	I.	Tr. I.	Internal contact	10 51 7·33	1 36 47·03	1 34		—	“

REMARKS.

Ref. No.
1 Very difficult observation.
2 Uncertain; difficult to say when exactly bisected.
3 Uncertain observation; eye very tired.
4 Very exact; first speck of light.
5 Very exact; planet splendidly defined.
6 Very exact.
7
8 Good observations.
9
10
11 Good observations.
12
13 Good observation.
14 Limb of planet indented by shadow.
16 Seen through cloud, but considered good.

Ref. No.
20 Shadow first seen.
21 Limb plainly indented; shadow considered to be bisected.
22 Good observation; limb and shadow sharply defined, but clouds passing over planet.
23
24 Very good observations; beautifully defined
25
29 Good.
31 Very good observation.
32 Shadow first seen.
33 Shadow bisected.
34 Limb complete.
36 Limb of planet indented.
37 Limb complete; external contact.
38 Very good observation; external contact lost; too late.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
		1876.				h m s	h m s	h m s	m s	
39	R	July 13	II.	Ec. R.	First seen	7 28 15·85	22 13 55·55	22 16 34·0	+ 2 38	200
40					Quite distinct	7 29 29·85	22 15 9·55	—	—	"
41					Full blaze (?)	7 30 13·85	22 15 53·55	—	—	"
42	R	"	I.	Oc. D.	External contact	8 3 4·80	22 48 44·50	22 31	—	"
43					Bisection (?)	8 4 47·80	22 50 27·50	—	—	"
44					Disappearance	8 7 27·30	22 53 7·00	—	—	"
45	R	"	I.	Ec. R.	First seen	11 21 13·50	2 6 53·20	2 7 15·5	+ 0 22	"
46					Quite distinct	11 23 23·50	2 9 3·20	—	—	"
47					Full blaze (?)	11 24 13·00	2 9 52·70	—	—	"
48	T	July 14	I.	Sh. I.	First seen	6 22 58·86	21 8 38·56	21 8	—	125
49					Bisection (?)	6 23 25·66	31 9 5·36	—	—	"
50					Internal contact	6 25 22·66	21 11 2·36	—	—	"
51	T	"	I.	Tr. E.	Internal contact	7 26 39·55	22 12 19·25	22 14	—	"
52					Bisection (?)	7 28 9·25	22 13 48·95	—	—	"
53					External contact	7 29 56·05	22 15 35·75	—	—	"
54	T	July 18	II.	Tr. I.	External contact	10 49 16·44	1 35 56·14	1 33	—	200
55					Internal contact	10 55 13·74	1 40 53·44	—	—	"
56	T	July 20	I.	Oc. D.	External contact	9 51 26·89	0 37 6·59	0 41	—	"
57					Disappearance	9 58 1·89	0 43 41·59	—	—	"
58	T	"	II.	Ec. R.	First seen	10 5 29·08	0 51 8·78	0 54 1·4	+ 2 53	"
59					Quite distinct	10 7 21·88	0 52 1·58	—	—	"
60					Full blaze (?)	10 9 26·88	0 55 6·58	—	—	"
61	T	July 21	I.	Tr. I.	External contact	7 5 10·70	21 50 50·40	21 52	—	"
62					Bisection (?)	7 7 0·70	21 52 40·40	—	—	"
63					Internal contact	7 9 21·70	21 55 1·40	—	—	"
64	T	"	I.	Sh. I.	First seen	8 17 39·58	23 3 19·28	23 3	—	"
65					Bisection (?)	8 18 41·58	23 4 21·28	—	—	"
66					Internal contact	8 20 38·58	23 6 18·28	—	—	"
67	T	"	I.	Tr. E.	Internal contact	9 13 37·50	23 59 17·20	0 5	—	"
68					Bisection (?)	9 16 43·50	0 2 23·20	—	—	"
69					External contact	9 18 44·50	0 4 24·20	—	—	"
70	T	"	I.	Sh. E.	Internal contact	10 22 16·38	1 7 56·08	1 16	—	"
71					Bisection (?)	10 24 16·88	1 9 56·58	—	—	"
72					Limb complete	10 26 18·28	1 11 58·58	—	—	"
73	T	July 28	I.	Tr. I.	External contact	8 56 34·47	23 42 14·17	23 45	—	"
74					Bisection (?)	8 58 44·77	23 44 24·47	—	—	"
75					Internal contact	9 1 12·27	23 46 51·97	—	—	"

76	T	July 30	I.	Sh. E.	Internal contact	6 46 34·93	21 32 14·63	21 40	—	“
77					Bisection (?)	6 48 54·93	21 34 34·63	—	—	“
78					Limb complete	6 50 54·93	21 36 34·63	—	—	“
79	T	Aug. 1	III.	Tr. I.	External contact	9 6 51·63	23 52 31·33	0 1	—	“
80					Bisection (?)	9 9 43·13	23 55 22·83	—	—	“
81					Internal contact	9 17 5·93	0 2 45·63	—	—	“
82	R	Aug. 12	III.	Oc. R.	External contact	5 19 30·26	20 5 9·96	22 10	—	“
83	R	“	II.	Tr. I.	External contact	7 36 23·00	22 22 2·70	22 17	—	“
84					Bisection	7 37 50·00	22 23 29·70	—	—	“
85					Internal contact	7 40 38·50	22 26 18·20	—	—	“
86	R	“	III.	Ec. D.	Satellite just visible	8 39 29·86	23 25 9·56	23 20 33·0	– 5 4	“
87					Disappearance	8 39 57·86	23 25 37·56	—	—	“
88	R	“	I.	Oc. D.	External contact	9 59 36·72	0 45 16·42	0 47	—	“
89					Bisection (?)	10 1 8·72	0 46 48·42	—	—	“
90					Disappearance	10 3 58·72	0 49 38·42	—	—	“
91	R	“	II.	Tr. E.	Internal contact	10 8 20·70	0 54 0·40	0 54	—	“
92					Bisection (?)	10 9 17·70	0 54 57·40	—	—	“
93					External contact	10 9 54·70	0 55 34·40	—	—	“
94	R	“	II.	Sh. I.	First seen	10 10 4·20	0 55 43·90	0 54	—	“
95					Limb indented	10 11 54·70	0 57 34·40	—	—	“
96					Internal contact	10 12 4·70	0 57 44·40	—	—	“
97	R	“	III.	Ec. R.	First seen	10 21 0·68	1 6 40·38	1 10 47·4	+ 4 7	“
98					Quite distinct	10 22 54·18	1 8 33·88	—	—	“
99					Full blaze (?)	10 23 55·68	1 9 35·38	—	—	“

REMARKS.

Ref. No.	
42 43	Good observations; planet and satellite splendidly defined.
44	The satellite was seen for some seconds as a very fine point of light, and suddenly disappeared at time noted, which was considered very exact.
45	Very good observation.
47	About full blaze.
48	A little way on limb of planet; planet badly defined throughout this phenomenon; could use only power 125.
51 52 53	Very badly defined and unsteady.
54	Very unsteady; satellite continually jumping off and on planet.
55	Very good observation.
58	First glimmer; very exact; thin clouds occasionally passing over planet; observation considered good.
63	Good observation.

Ref. No.	
66	Limb complete.
67	May be a little early.
69	Very exact; good observation.
70 71 72	Limb very unsteady and only well defined occasionally, rendering observation extremely difficult.
73	Good observation.
74	Good observation.
78	Last seen; limb complete; good; planet's limb very sharply defined.
82	Rather late; much before expected time; when seen the whole of the satellite was visible.
87	Last seen; good observation.
90	For several seconds before disappearance the satellite seemed to be visible inside limb of planet, as if projected on planet.
94	The limb a little indented.
96	Limb complete; may be a little late.
97	Very good observation; first seen as a minute speck of light.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
		1876.				h m s	h m s	h m s	m s	
100	R	Aug. 13	I.	Tr. I.	External contact	7 12 20·80	21 58 0·50	22 1	—	200
101					Bisection (?)	7 14 46·80	22 0 26·50	—	—	“
102					Internal contact	7 16 59·80	22 2 39·50	—	—	“
103	R	“	I.	Sh. I.	First seen	8 32 23·65	23 18 3·35	23 18	—	“
104					Bisection (?)	8 33 8·65	23 18 48·35	—	—	“
105					Limb complete	8 33 56·65	23 19 36·35	—	—	“
106	R	“	I.	Tr. E.	Internal contact	9 25 41·52	0 11 21·22	0 14		“
107					Bisection (?)	9 27 25·52	0 13 5·22	—	—	“
108					External contact	9 28 13·52	0 13 53·22	—	—	“
109	R	Aug. 14	II.	Ec. R.	First seen	7 17 6·95	22 2 46·65	22 5 19·1	+ 2 32	“
110					Quite distinct	7 17 33·95	22 3 13·65	—	—	“
111					Full blaze (?)	7 18 48·95	22 4 28·65	—	—	“
112	R	“	I.	Ec. R.	First seen	7 57 21·87	22 43 1·57	22 43 31·6	+ 0 30	“
113					Quite distinct	7 57 58·87	22 43 38·57	—	—	“
114					Full blaze (?)	7 58 58·87	22 44 38·57	—	—	“
115	R	Aug. 19	III.	Oc. D.	External contact	7 8 16·80	21 53 56·50	21 57	—	“
116					Bisection (?)	7 12 40·30	21 58 20·00	—	—	“
117					Disappearance	7 19 46·30	22 5 26·00	—	—	“
118	R	“	III.	Oc. R.	First seen	9 17 35·05	0 3 14·75	0 10	—	“
119					Bisection (?)	9 20 47·55	0 6 27·25	—	—	“
120					External contact (?)	9 28 15·55	0 13 55·25	—	—	“
121	T	Aug. 20	I.	Tr. I.	External contact	9 8 15·30	23 58 55·00	23 56	—	“
122					Bisection	9 10 20·30	22 56 0·00	—	—	“
123					Internal contact	9 12 37·30	23 58 17·00	—	—	“
124	T	Aug. 21	I.	Oc. D.	External contact	6 23 52·24	21 9 31·94	21 11	—	“
125					Bisection (?)	6 25 41·54	21 11 21·24	—	—	“
126					Disappearance	6 27 57·54	21 13 37·24	—	—	‘
127	T	“	II.	Oc. R.	First seen	7 18 55·43	22 4 35·13	22 8	—	“
128					Bisection (?)	7 19 51·93	22 5 31·63	—	—	
129					External contact (?)	7 22 40·43	22 8 20·13	—	—	“
130	T	“	II.	Ec. D.	Disappearance	7 23 55·42	22 9 35·12	22 8 54·3	– 0 41	‘
131	T	“	I.	Ec. R.	First seen	9 52 23·16	0 38 2·86	0 38 17·3	+ 0 14	125
132					Quite distinct	9 53 52·16	0 39 31·86	—	—	“
133					Full blaze (?)	9 55 54·16	0 41 33·86	—	—	“
134					First seen	9 55 19·16	0 40 58·86	0 43 5·9	+ 2 7	“
135					Quite distinct	9 57 21·15	0 43 0·85	—	—	“

136	T	“	II.	Ec. R.	I. and II. Satellites equally bright	9 58 1·15	0 43 40·85	—	—	
137					Full blaze (?)	9 59 49·15	0 45 28·85	—	—	“
138	R	Aug. 22	I.	Sh. E.	Internal contact	7 2 26·62	21 48 6·32	21 55	—	200
139					Bisection (?)	7 3 41·62	21 49 21·32	—	—	“
140					Limb complete	7 6 1·62	21 51 41·32	—	—	“
141	T	Aug. 28	II.	Oc. D.	External contact	7 20 55·60	22 6 35·30	22 11	—	“
142					Bisection (?)	7 22 29·30	22 8 9·00	—	—	“
143						7 24 5·60	22 9 45·30	—	—	“
144					Disappearance	7 25 59·60	22 11 39·30	—	—	“
145	T	“	I.	Oc. D.	External contact	8 11 19·47	23 4 59·17	23 7	—	“
146					Bisection (?)	8 20 56·97	23 6 36·67	—	—	“
147					Disappearance	8 23 38·97	23 9 18·67	—	—	“
148	T	Aug. 29	I.	Sh. I.	First seen	6 51 57·52	21 37 37·22	21 38	—	“
149					Internal contact	6 54 45·52	21 40 25·22		—	“

REMARKS.

Ref. No.	
100 101 102	Good observations; well defined.
103	Very good.
108	Could not obtain egress of shadow; last seen about twice its diameter from limb of planet; power 125.
109	Very good observation; suddenly appearing as a very minute speck of light.
112	Good observation; suddenly appearing as a very minute speck of light.
115	Very steady and well defined.
116	Appeared as a well defined nipple protruding from planet; very steady and well defined.
117	Very good; steady and well defined; suddenly disappearing; satellite appeared as if projected on planet, and in internal contact a full minute before its final disappearance.
118	First seen as a fine point of light, a little outside limb of planet; throughout this phenomenon, which was very good and well defined, there was a dark line or sensible space between satellite and limb of planet.
121 122 123	Very good and well defined.
124 125 126	Very good; steady and well defined; after bisection the satellite was seen as if projected on limb of planet.
127	Quite a minute late (?) emerging at a sensible distance from limb or edge of planet.
128	Immediately after this the satellite commenced to diminish in brightness; entering shadow.
129	Supposed external contact, but satellite becoming very dim, as it entered shadow immediately after reappearance.
130	Very exact; close to limb of planet, to which it appeared to cling as it diminished in brightness.
134	The second satellite reappeared before the first was full blaze.
136	The two satellites equal in brightness, and about 1½ to 2 diameters apart, appearing as a pretty double star; these two phenomena were very good observations; steady and well defined.
138	Not very good; limb very unsteady.
139	Fair observation.
140	Supposed external contact.
143	Satellite quite distinctly seen, as if projected on planet.
144	Last seen.
145	Not very good; hazy, and thin cloud over sky; planet and satellite unsteady; good only in glimpses.
148	When first seen nearly bisected.
149	A very good observation; planet fairly well defined.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
		1876.				h m s	h m s	h m s	m s	
150	T	Aug. 29	I.	Tr. E.	Internal contact	7 45 15·90	22 30 55·60	23 35	—	200
151					Bisection (?)	7 46 56·90	22 32 36·60	—	—	“
152					External contact	7 48 59·90	22 34 39·60	—	—	“
153	T	Aug. 30	I.	Ec. R.	First seen	6 15 36·57	21 1 16·27	21 1 44·9	+ 0 29	“
154					Quite distinct	6 16 17·07	21 1 56·77	—	—	“
155					Full blaze (?)	6 19 7·07	21 4 46·77	—	—	“
156	T	“	III.	Sh. I.	First seen	6 18 54·57	21 4 34·27	21 5	—	“
157					Limb indented	6 25 57·54	21 11 37·24	—	—	“
158					Internal contact	6 27 47·04	21 13 26·74	—	—	“
159	T	“	II.	Sh. E.	Internal contact	7 3 17·95	21 48 57·65	21 58	—	“
160					Limb broken	7 4 36·95	21 50 16·65	—	—	“
161					Bisection (?)	7 5 43·95	21 51 23·65	—	—	“
162					Limb complete	7 7 21·95	21 53 1·65	—	—	“
163	T	“	III.	Sh. E.	Internal contact	8 3 52·80	22 49 32·50	23 10	—	“
164					Limb broken	8 5 47·80	22 51 27·50	—	—	“
165					Bisection (?)	8 9 26·80	22 55 6·50	—	—	“
166					Limb indented	8 13 28·80	22 59 8·50	—	—	“
167					Limb indented	8 14 52·30	23 0 32·00	—	—	“
168					Limb complete	8 17 5·80	23 2 45·50	—	—	“
169	R	Sept. 5	I.	Tr. I.	External contact	7 32 30·97	22 18 10·67	22 20	—	“
170					Bisection (?)	7 33 43·97	22 19 23·67	—	—	“
171					Internal contact	7 35 19·47	22 20 59·17	—	—	“
172	T	Sept. 6	II.	Sh. I.	First seen	7 11 42·30	21 57 22·00	21 55	—	“
173					Internal contact	7 14 54·30	22 0 34·00	—	—	“
174	T	“	II.	Tr. I.	Internal contact	7 15 48·80	22 1 28·50	22 4	—	“
175					Bisection (?)	7 19 20·30	22 5 0·00	—	—	“
176					External contact	7 22 5·29	22 7 44·99	—	—	“
177	T	“	III.	Tr. E.	Internal contact	7 21 13·79	22 6 53·49	22 21	—	“
178					Bisection (?)	7 25 39·29	22 11 18·99	—	—	“
179					External contact	7 33 30·28	22 19 9·98	—	—	“
180	T	“	I.	Ec. R.	First seen	8 10 22·20	22 56 1·90	22 56 29·6	+ 0 28	“
181					Quite distinct	8 10 59·20	22 56 38·90	—	—	“
182					Full blaze (?)	8 14 14·20	22 59 53·90	—	—	“

183	R	Sept. 13	II.	Tr. I.	External contact	7 24 42·05	22 10 21·75	22 7	—	“
184					Bisection (?)	7 26 50·05	22 12 29·75	—	—	“
185					Internal contact	7 30 2·55	22 15 42·25	—	—	“
186	T	Sept. 17	III.	Ec. R.	First seen	6 18 30·32	21 4 10·02	21 8 48·4	+ 4 38	125
187					Full blaze (?)	6 28 41·61	21 14 21·31	—	—	“
188	T	Sept. 20	I.	Oc. D.	External contact	8 40 14·00	23 25 53·70	23 39	—	“
189					Bisection (?)	8 41 41·00	23 27 20·70	—	—	“
190					Disappearance	8 43 55·00	23 29 34·30	—	—	“
191	R	Sept. 22	I.	Ec. R.	First seen	6 28 33·97	21 14 13·67	21 14 37·3	+ 0 24	200
192					Quite distinct	6 29 8·97	21 14 48·67	—	—	“
193					Full blaze (?)	6 30 33·97	21 16 13·67	—	—	“
194	T	“	II.	Ec. R.	First seen	9 45 30·55	0 31 10·25	0 33 18·7	+ 2 8	125
195					Quite distinct	9 46 51·55	0 32 31·25	—	—	“
196					Full blaze (?)	9 50 8·55	0 35 48·25	—	—	“
197	T	Sept. 24	III.	Oc. R.	External contact	6 16 31·92	21 2 11·62	21 2	—	200
198	T	“	III.	Ec. D.	Disappearance	8 32 50·02	23 18 29·72	23 13 51·1	– 3 39	125

REMARKS.

Ref. No.
152 A very good observation; could not make out the shadow at egress.
153 Very good.
156 When first seen limb sensibly indented, as I was watching for full blaze of first satellite.
158 Limb complete; definition excellent.
162 Limb complete; throughout this observation, which was very good, the planet being well defined, the shadow of III. satellite was traversing the polar regions of *Jupiter* in high north latitude, and appeared very large and distinct; slightly but sensibly oval.
163 Tangential and well defined in glimpses.
164 Limb sensibly broken.
167 Limb still indented.
168 Last seen; limb complete; considered very good throughout this phenomenon.
169 170 171 Good; very steady and well defined throughout.
172 Steady and well defined, but at times a boiling motion on limb; well on when first seen.
173 to 179 Steady and well defined, but at times a boiling motion on limb.

Ref. No.
174 Good.
176 Good; satellite faint, lying on a bright cloud belt.
177 A little late.
179 Good observation.
180 Very good; first seen as a minute speck of light.
183 184 185 Unsteady; limb boiling.
186 Very good; first seen as a minute speck of light.
188 189 190 Badly defined; edges of planet woolly and ragged.
191 First seen as a minute speck of light; very faint; considered good.
192 193 Considered good.
194 195 196 Good.
197 Too late for first appearance.
198 Very exact.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Observer.	Day of Observation.	Satellites.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
		1876.				h m s	h m s	h m s	m s	
199	T	Oct. 7	I	Tr. E.	Internal contact	6 39 54·70	21 25 54·40	21 30	—	200
200					Bisection (?)	6 41 35·20	21 27 14·90	—	—	"
201					External contact	6 43 24·20	21 29 3·90	—	—	"
202	T	Oct. 8	II.	Tr. E.	Internal contact	7 29 28·45	22 15 8·15	22 20	—	"
203					Bisection (?)	7 33 13·45	22 18 53·15	—	—	"
204					External contact	7 36 18·45	22 21 58·15	—	—	"
205	T	Oct. 14	I.	Tr. I.	External contact	6 29 3·04	21 14 42·74	21 17	—	"
206					Bisection (?)	6 30 52·54	21 16 32·24	—	—	"
207					Internal contact	6 32 57·54	21 18 37·24	—	—	"
208	T	"	I.	Sh. I.	First seen	7 21 50·98	22 7 30·68	22 6	—	125
209					Internal contact	7 26 2·98	22 11 42·68	—	—	"
210	T	Oct. 15	I.	Ec. R.	First seen	6 41 6·36	21 26 46·06	21 27 8·6	+ 0 23	"
211					Full blaze (?)	6 44 7·36	21 29 47·06	—	—	"
212	T	"	II.	Tr. I.	External contact	7 39 22·26	22 25 1·96	22 27	—	200
213					Bisection (?)	7 42 42·26	22 28 21·96	—	—	"
214					Internal contact	7 45 59·26	22 31 38·96	—	—	"

REMARKS.

Ref. No.	
199 200 201	Very good; fairly steady.
202 203 204	Considered good; planet well defined, but limb rather unsteady.
205 206 207	Very good.
208 209	Both worthless; limb too unsteady and ill defined.
210 211	Wonderfully beautiful view of planet; splendidly defined.
211	As bright as No. II. close by, the two making a pretty double star.
212 213 214	Good, but not so well defined as at the previous observation.

NOTES ON PHYSICAL APPEARANCE OF PLANET, 1876.

June 28th, 8·30 p.m.—From about 10° north latitude to about 20° to 25° south latitude the planet was of a bright salmon color, varied by streaks and patches of cumulus-looking clouds, more especially in the southern portion. Over each temperate zone there was a very decided belt of bright cumulus cloud, between which and the poles the surface was of a greyish-green or olive-green color, mottled with streaks and patches of cloud. The outlines of the bright cloud belts were very marked and well defined.—R.

July 30th, 6·35.—On either side of the equator, reaching to about latitude 15°, the planet was of a pale salmon color, mottled with small detached cumulus or cirro-cumulus looking clouds and narrow white parallel streaks. The southern margin of this band was bounded by a long bank of cumulus cloud, reaching diagonally from latitude 15° or 20° on east limb to about latitude 35° on west limb, dividing into two branches on west side of the planet's polar diameter. From the poles to about latitude 60° the planet was of a dull greyish-green, varied with a few bright belts.—T.

August 29th, 7·30.—From about 15° north latitude to 15° south latitude the planet was of a salmon color, over the southern half of which were scattered clouds, between which the salmon colored ground was visible. Between latitude 15° and 25° north there was a very bright belt of cloud, having its northern edge very marked and well defined. Between this and the northern pole there were less brilliant cloud belts, overlying a greyish-green ground. Scattered clouds around pole.

The scattered clouds south of the equator had a remarkable dark band, which seemed to be a rift in the clouds, south of which the clouds had a dull appearance. In the temperate regions of the southern hemisphere, as also in the northern, there was the greyish-green color seen between scattered clouds; and round the south pole was of a light-greyish color.

During this observation it was particularly remarked that in the northern hemisphere the north edge of belts and clouds was the most marked and well defined, which also applied to the south sides of same in the southern hemisphere.—R.

October 15th, 6·42.—Wonderfully beautiful view of planet, definition splendid. Over the equatorial regions, for a space of about 15° or 20° on either side of the equator, were delicate streaks of cloud, some being knotted like small cumulus or cirro-cumulus resting on a background of a deep salmon tint. Towards the south a bank of cumulus, having its horizontal base towards the equator, reached across the planet. This bright band, which had the roundish outline of cumulus, reached nearer to the south pole than usual, or to within about 40° of the pole, varied by dark spaces here and there. The north pole was of the usual greyish-green tint, bounded by a broad bright band over the temperate or middle zone.—T.

On one or two occasions at occultation disappearance the satellite appeared to be projected on the limb, or more strictly speaking, was visible through the edge of the planet, as if the latter were surrounded by a transparent cloud-laden atmosphere. I noticed this singular phenomenon on two occasions, viz., at the disappearance of the first satellite on August 21st, when the satellite was distinctly seen on or through the disc for about two minutes before disappearance, the satellite being less bright than when in a similar position at transit; and again at the occultation of the second satellite, on August 28th. Mr. Ringwood also noticed it on August 12th, at disappearance of first satellite, and on August 19th, at disappearance of the third satellite. In each instance the planet was splendidly defined. This phenomenon was never seen at any reappearance. At the reappearance of the third satellite on August 19th, and the second satellite on August 21st, when the planet was past quadrature, the satellites, at instant of emergence, were sensibly separated from the illuminated edge of the planet. The shadow of the third satellite, when in mid-transit along a high northern parallel on August 30th appeared to me to be visibly oval or flattened at its poles, the definition at the time being all that could be desired.—T.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observation of Eclipses. Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE 9h. 14m, 20·3s. East. ‖ LATITUDE, 34° 55′ 38″·5 South.

1877

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power
	1877.				h m s	h m s	h m s	m s	
1	June 1, 8·54	T	I Sh. I.	First seen	8 53 27·1	23 39 6·8	23 39	—	200
2				About bisected	8 54 29·1	23 40 8·8	—	—	“
3				Internal contact	8 55 39·1	23 41 18·8	—	—	“
4	“ 9·20	T	I Tr. I.	First contact	9 17 52·1	0 3 31·8	0 5	—	“
5				Bisected	9 19 58·1	0 5 37·8	—	—	“
6				Internal contact	9 21 36·6	0 7 16·3	—	—	“
7	“ 11·6	T	I. Sh. E.	Internal contact	11 5 9·9	1 50 49·6	1 54	—	“
8				Bisected	11 6 39·9	1 52 19·6	—	—	“
9				Limb complete	11 8 13·9	1 53 53·6	—	—	“
10	“ 11·32	T	I. Tr. E.	Internal contact	11 30 46·4	2 16 26·1	2 21	—	“
11				Bisected	11 32 12·9	2 17 52·6	—	—	“
12				External contact	11 34 19·9	2 19 59·6	—	—	“
13	June 2, 7·40	T	III. Oc. R.	First seen	7 34 52·3	22 20 32·0	22 27	—	“
14				About bisected	7 38 52·3	22 24 32·0	—	—	‘
15				External contact	7 42 32·3	22 28 12·0	—	—	
16	“ 8·53	T	I. Oc. R.	First seen	8 51 44·2	23 37 23·9	23 39	—	
17				About bisected	8 52 55·2	23 38 34·9	—	—	
18				External contact	8 54 40·2	23 40 19·9	—	—	“
19	June 3, 9·43	T	II. Sh. I.	External contact	—	—	0 25	—	“
20				Internal contact	9 43 31·8	0 29 11·5	—	—	“
21	“ 10·28	T	II. Tr. I.	External contact	10 26 1·7	1 11 41·4	1 12	—	“
22				Bisected	10 28 21·7	1 14 1·4	—	—	“
23				Internal contact	10 30 21·7	1 16 1·4	—	—	“
24	June 9, 7·20	T	III. Ec. D.	—	7 20 34·1	22 6 13·8	22 4 40	– 1 34	125
25	“ 8·9	T	I. Ec. D.	—	8 8 45·0	22 54 24·7	22 54 3	– 0 22	“
26	“ 10·37	T	I. Oc. R.	First seen	10 35 38·7	1 21 18·4	1 23	—	200
27				Bisected	10 37 8·7	1 22 48·4	—	—	“
28				External contact	10 38 38·7	1 24 18·4	—	—	“
29	“ 10·52	T	III. Oc. R.	First seen	10 52 33·7	1 38 13·4	1 45	—	“
30				Bisected	10 56 8·7	1 41 48·4	—	—	“
31				External contact	11 0 3·7	1 45 43·4	—	—	“

32 33 34	June 12	6·30	R	II. Ec. D.	Very dim	6 30 32·5	21 16 12·2	21 16 9	– 0 33	125
					Just visible	6 30 52·5	21 16 32·2	—	—	"
					Disappeared	6 31 2·5	21 16 42·2	—	—	"
35 36 37	"	9·36	R	II. Oc. R.	First seen	—	—	0 23	—	"
					Past bisection	9 36 53·8	0 22 33·5	—	—	"
					External contact	9 37 19·3	0 22 59·0	—	—	"
38	June 16,	10·3 .		I. Ec. D.	—	10 3 13·1	0 48 52·8	0 48 21	– 0 32	"
39	"	11·20 .		III. Ec. D.	—	11 19 43·5	2 5 23·2	2 3 22	– 2 1	"
40 41 42	June 17,	7·13	T	I. Tr. I.	External contact	7 12 3·1	21 57 42·8	21 59	—	200
					Bisected	7 13 33·1	21 59 12·8	—	—	"
					Internal contact	7 15 23·1	22 1 2·8	—	—	"
43 44 45	"	9·24	T	I. Sh. E.	Internal contact	9 21 56·0	0 7 35·7	0 11	—	"
					About bisected	9 23 3·0	0 8 42·7	—	—	"
					Last seen	9 24 9·0	0 9 48·7	—	—	"
46 47 48	"	9·27	T	I. Tr. E.	Internal contact	9 24 29·0	0 10 8·7	0 14	—	"
					Bisected	9 25 51·0	0 11 30·7	—	—	"
					External contact	9 27 43·0	0 13 22·7	—	—	"
49 50 51	June 18,	6·47	T	I. Oc. R.	First seen	6 45 59·0	21 31 38·7	21 23	—	125
					About bisected	6 47 0·5	21 32 40·2	—	—	"
					External contact	6 48 19·5	21 33 59·2	—	—	"

REMARKS.

Ref. No.	
1	Limb slightly indented.
10	Very exact.
12	Good observation.
13	Little late; very ill defined and hazy throughout.
18	Good observation.
19	Lost; came too late.
20	Not good; badly defined; sky hazy.
21 22 23	Good; fair definition.
24	Very exact; planet wretchedly defined.
25	Good observation.
26 27 28	Not well defined.
29	May be a little late.
30	Good; planet not very well defined, clouds passing. Had an impression that I saw about half the satellite through edge of planet.

Ref. No.	
33	Mere speck of light.
35	Lost by clouds.
37	Doubtful.
38	Very good, disappearing close to planet, which was beautifully defined; closeness to planet may affect time of disappearance.
39	Very exact; close proximity to planet may, however, affect observation; splendidly defined
40 41 42	The satellite entered the planet on the northern margin of the dark belt north of the planet's equator, and its shadow, which preceded it, was not seen till about 7h. 16m. A.M.T. when it appeared in about tangential contact with the satellite, which could be followed for a considerable space across the disc of the planet; the shadow was very sharply defined. Passing clouds partially obscured the planet at times, and the limb was often wavy and tremulous, but the times noted were considered good.
43 44 45	Five minutes before internal contact of shadow, the shadow and satellite appeared to be in contact, both, especially the shadow, being sharply defined.
49	Considered rather late; thin fog clouds over sky.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1877.				h m s	h m s	h m s	m s	
52	June 19, 9·5	R	II. Oc. D.	External contact	9 1 18·1	23 46 57·8	23 50	—	200
53				About bisected	9 3 29·6	23 49 9·3	—	—	“
54				Internal contact	9 5 14·6	23 50 54·3	—	—	“
55				Last seen	9 5 29·1	23 51 8·8	—	—	“
56	June 24, 8·57	T	I. Tr. I.	External contact	8 55 53·8	23 41 33·5	23 42	—	“
57				Bisected	8 57 11·8	23 42 51·5	—	—	“
58				Internal contact	8 58 43·8	23 44 23·5	—	—	“
59	“ 9·4	T	I. Sh. I.	First seen	9 2 34·8	23 48 14·5	23 49	—	“
60				About bisected	9 3 54·8	23 49 34·5	—	—	“
61				Internal contact	9 5 39·8	23 51 19·5	—	—	“
62	June 25, 8·37	R	I. Ec. R.	First seen	8 37 6·3	23 22 46·0	23 23 4	+ 0 18	“
63				Quite distinct	8 37 37·8	22 23 17·5	—	—	“
64				Full blaze (?)	8 39 17·8	23 24 57·5	—	—	“
65	June 27, 6·58	T	III. Tr. E.	Internal contact	6 54 38·0	21 40 17·7	21 51 0	—	“
66				About bisected	6 57 57·5	21 43 37·2	—	—	“
67				External contact	7 1 59·0	21 47 38·7	—	—	“
68	“ 7·45	T	III. Sh. E.	Internal contact	7 41 9·0	22 26 48·7	22 36	—	“
69				About bisected	7 44 59·0	22 30 38·7	—	—	“
70				Limb complete	7 48 4·0	22 33 43·7	—	—	“
71	June 28, 6·47	T	II. Sh. I.	External contact	—	—	21 30	—	“
72				Nearly bisected	6 47 20·1	21 32 59·8	—	—	“
73	“ 9·4	T	II. Tr. E.	Internal contact	9 1 26·1	23 47 5·8	23 53	—	“
74				About bisection	9 4 30·4	23 50 10·1	—	—	“
75				External contact	9 6 19·9	23 51 59·6	—	—	“
76	“ 9·30	T	II. Sh. E.	Internal contact	9 28 6·9	0 13 46·6	0 18	—	“
77				About bisection	9 29 38·9	0 15 18·6	—	—	“
78				Limb complete	9 31 33·4	0 17 13·1	—	—	“
79	July 2, 8·0	T	I. Oc. D.	External contact	7 56 59·0	22 42 38·7	22 46	—	“
80				About bisected	7 58 39·0	22 44 18·7	—	—	“
81				Internal contact	8 1 15·7	22 46 55·4	—	—	“
82				Disappearance	8 2 13·5	22 47 53·2	—	—	“
83	July 3, 7·20	T	I. Tr. E.	Internal contact	7 17 15·2	22 2 54·9	22 8	—	“
84				About bisected	7 18 28·2	22 4 7·9	—	—	“
85				External contact	7 20 15·2	22 5 54·9	—	—	“
86	“ 7·35	T	I. Sh. E.	Internal contact	7 36 18·2	22 21 57·9	22 28	—	“
87				About bisected	7 37 30·2	22 23 9·9	—	—	“
88				Limb complete	7 39 39·2	22 25 18·9	—	—	“

89	July 5,	8·37	T	II. Tr. I.	External contact	8 34 46·2	23 20 25·9	23 22	—	300
90					Bisected	8 36 45·2	23 22 24·9	—	—	“
91					Internal contact	8 38 44·2	23 24 23·9	—	—	“
92	“	9·23	T	II. Sh. I.	First seen	9 20 49·1	0 6 28·8	0 6	—	“
93					About bisected	9 22 27·6	0 8 7·3	—	—	
94					Internal contact	9 24 27·1	0 10 6·8	—	—	“
95	“	11·20	T	II. Tr. E.	Internal contact	11 17 18·0	2 2 57·7	2 9	—	200
96					About bisection	11 19 8·0	2 4 47·7	—	—	“
97					External contact	11 21 31·5	2 7 11·2	—	—	“
98	“	12·6	T	II. Sh. E.	Internal contact	12 3 44·0	2 49 23·7	2 54	—	“
99					Bisected	12 5 38·0	2 51 17·7	—	—	“
100					Limb complete	12 7 55·5	2 53 35·2	—	—	“
101	July 7,	6·15	T	II. Ec. R.	—	6 14 44·2	21 0 23·9	21 1 52	+ 1 28	“
102	July 11,	6·57	R	I. Ec. R.	First seen	6 54 53·3	21 40 33·0	21 40 53	+ 0 20	“
103					Quite distinct	6 55 18·3	21 40 58·0	—	—	“
104					Full blaze	6 58 4·3	21 43 44·0	—	—	“

REMARKS.

Ref. No.	
52	Good.
54	Internal contact with the limb of planet.
55	Very good; disappeared behind white cloud belt, but did not finally disappear till within the limb, or about 14½s. after time noted of internal contact.
56 57 58 59 60 61	Good; satellite and shadow entered on dark belt north of the equator. Definition of planet superb.
62	A mere speck.
63 64	Very good, well defined; moon close by.
65 66 67	Difficult observations, owing to bad definition of satellite external contact good.
68 69 70	Considered good; clouds passing.
72	Cloudy; internal contact not seen.
73	Very exact.
79	The satellite disappeared behind the dark belt south of the equator, and was distinctly seen through the edge of the planet, for the space of its full diameter not finally disappearing till about one minute after internal contact, the occultation being effected at some distance within the limb. At 7h. 59m. 18s. and at 8h. 0m. 53s. the satellite was noted as partly behind, or immersed in the planet, and partly protruding as a small nipple on the limb.
85	Satellite passed off north dark belt.
87	Shadow traversed the north dark belt.
89 90 91	Very good observation, both planet and satellite well defined; the satellite just within the bright band north of the dark belt.
92 93 94	Good observation; shadow very sharply defined. The satellite faintly visible opposite to a bright spot on south side of dark belt.
95 96 97	Internal contact a little early; planet not so well defined as at ingress; foggy.
98 99 100	Planet not so well defined; but observations considered good.
101	Good, caught first glimmer. Observed also by R., with 4-in. object glass; time noted being 6h. 15m. 21·9s. A.M.T.
102 103 104	Planet not well defined, but observation good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time. 1877.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
					h m s	h m s	h m s	m s	
105	July 14, 8·51	T	II. Ec. R.	—	8 50 38·0	23 36 17·7	23 37 50	+ 1 32	200
106	July 19, 5·57	R	I. Sh. E.	Internal contact	5 54 51·6	20 40 31·3	20 46	—	"
107				About bisected	5 55 57·6	20 41 37·3	—	—	"
108				Limb complete	5 57 27·6	20 43 7·3	—	—	"
109	July 21, 7·15	T	II. Oc. D.	External contact	7 12 29·8	21 58 9·5	22 1	—	"
110				About bisected	7 14 48·8	22 0 28·5	—	—	"
111				Internal contact	7 17 18·8	22 2 58·5	—	—	"
112	" 11·28	T	II. Ec. R.	First seen	11 26 30·5	2 12 10·2	2 14 3	+ 1 53	"
113				Full blaze	11 31 3·5	2 16 43·2	—	—	"
114	July 22, 6·50	T	III. Oc. R.	First seen	6 46 51·8	21 32 31·5	21 40	—	"
115				About bisected	6 49 21·8	21 35 1·5	—	—	"
116				External contact	6 53 11·8	21 38 51·5	—	—	"
117	" 7·10	T	III. Ec. D.	Becoming dim	7 4 1·8	21 49 41·5	21 57 43	− 1 22	"
118				Sensibly dimmer	7 5 32·8	21 51 12·5	—	—	"
119				Disappeared	7 13 25·8	21 59 5·5	—	—	"
120	" 9·50	T	III. Ec. R.	First seen	9 48 33·6	0 34 13·3	0 38 25	+ 4 12	"
121				Full blaze	9 58 1·6	0 43 41·3	—	—	"
122	July 24, 10·21	T	I. Tr. I.	External contact	10 20 55·2	1 6 34·9	1 9	—	"
123				About bisected	10 22 27·7	1 8 7·4	—	—	"
124				Internal contact	10 24 52·2	1 10 31·9	—	—	"
125	" 11·10	T	I. Sh. I.	First seen	11 9 29·1	1 55 8·8	1 56	—	"
126				About bisected	11 10 54·6	1 56 34·3	—	—	"
127				Internal contact	11 12 51·6	1 58 31·3	—	—	"
128	July 25, 7·41	T	I. Oc. D.	External contact	7 41 4·2	22 26 43·9	22 28	—	300
129				Disappeared	7 44 45·2	22 30 24·9	—	—	"
130	July 28, 9·38	T	II. Oc. D.	External contact	9 31 20·1	0 16 59·8	0 21	—	200
131				About bisected	9 33 58·1	0 19 37·8	—	—	"
132				Disappeared	9 37 9·1	0 22 48·8	—	—	"
133	July 29, 7·42	T	III. Oc. D.	External contact	7 30 49·8	22 16 29·5	22 22	—	"
134				About bisected	7 35 44·8	22 21 24·5	—	—	"
135				Disappeared	7 41 24·8	22 27 4·5	—	—	"
136	" 10·17	T	III. Oc. R.	First seen	10 16 14·4	1 1 54·1	1 8	—	"
137				About bisected	10 20 4·4	1 5 44·1	—	—	"
138				External contact	10 25 14·4	1 10 54·1	—	—	

139	July 30,	6·30	T	II. Sh. I.	First seen	6 28 17·5	21 13 57·2	21 13	—	“
140					About bisected	6 29 3·0	21 14 42·7	—	—	“
141					Internal contact	6 21 3·0	21 16 42·7	—	—	“
142	Aug. 1,	9·30	T	I. Oc. D.	External contact	9 29 28·5	0 15 18·2	0 16	—	“
143					About bisected	6 31 7·5	0 16 47·2	—	—	“
144					Disappeared	9 32 34·5	0 18 14·2	—	—	“
145	Aug. 2,	6·37	T	I. Tr. I.	External contact	6 36 38·4	21 22 18·1	21 23	—	“
146					About bisection	6 38 19·9	21 23 59·6	—	—	“
147					Internal contact	6 40 3·9	21 25 43·6	—	—	“
148	“	7·37	T	I. Sh. I.	External contact	—	—	22 19	—	“
149					Internal contact	7 36 23·8	22 22 3·5	—	—	“
150	“	8·50	T	I. Tr. E.	Internal contact	8 48 27·6	23 34 7·3	23 39	—	“
151					About bisected	8 50 30·6	28 36 10·3	—	—	“
152					External contact	8 52 58·6	23 38 38·3	—	—	“

REMARKS.

Ref. No.
105 Very good; caught first glimmer.
106
107 Very good; shadow traversed dark band.
108
109
110 Very good; planet well defined; satellite disappeared a little south of southern dark belt, behind a bank of white cloud, and at times I thought I could see the whole of the satellite immersed in the planet up to internal contact.
111
112 Good; a mere speck of light.
114 Time late.
116 Good; planet and satellite well defined.
117
118 The disc of the satellite was very sharply defined. The time first noted is when I first observed an alteration in the outline of the disc, the altered form being well marked at the second time, when the shadow appeared to extend over nearly one-third of the disc; the satellite was reduced to a mere speck of light for at least a minute before disappearance, and I lost sight of it for a few seconds, about 10 seconds before the time noted (119), but caught it again, and the time given must be very exact.
119
120 Good; seen instantly.
121 Disc perfect.
122
123 Bad definition.
124
125
126 External contact doubtful; definition wretched.
127

Ref. No.
128 Not good; clouds interfering. Satellite disappeared behind a bright white cloud belt.
129
130 Not very good.
131 Not very good.
132 Exact.
133 Good.
134 Good.
135 Exact.
136 A little late; badly defined.
138 Good; but planet badly defined.
139
140 Very badly defined; not considered good.
141
142
143 External contact considered late; disappearance very exact; planet and satellite well defined. The satellite disappeared behind and about the middle of the dark belt south of the equator. The dark belts on either side of the equator were hazy, and seemingly covered with a thin cloud. The occultation was perfect at limb. No appearance of satellite as it passed behind the planet, but the Jovian clouds seemed denser than usual.
144
145
146 Very steady, and time noted considered very exact. The dark streaks appeared to be covered with a thin film of cloud, or as if seen through fog.
147
148 Good. *Vide* description.
149

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1877.				h m s	h m s	h m s	m s	
153	Aug. 2, 9·49	T	I. Sh. E.	Internal contact	—	—	0 36	—	200
154				About bisected	9 46 57·0	0 32 36·7	—	—	“
155				Limb complete	9 48 15·0	0 33 54·7	—	—	“
156	“ 8, 6·0	R	II. Ec. R.	First seen	5 58 6·5	20 43 46·2	20 45 23	+ 1 37	“
157				Quite distinct	5 58 29·5	20 44 9·2	—	—	“
158				Full blaze	6 0 39·5	20 46 19·2	—	—	“
159	“ 11·20	T	I. Oc. D.	External contact	11 17 24·8	2 3 4·5	2 4	—	“
160				About bisected	11 19 11·8	2 4 51·5	—	—	“
161				Disappearance	11 21 15·8	2 6 55·5	—	—	“
162	Aug. 9, 8·26	T	I. Tr. I.	External contact	8 24 40·9	23 10 20·6	23 12	—	“
163				About bisected	8 26 51·9	25 12 31·6	—	—	“
164				Internal contact	8 28 25·9	23 14 5·6	—	-	“
165	“ 9·30	T	I. Sh. I.	First seen	9 28 17·8	0 13 57·5	0 14	—	“
166				About bisected	9 28 59·8	0 14 39·5	—	—	“
167				Internal contact	9 31 23·8	0 17 23·5	—	—	“
168	Aug. 11, 6·10	T	I. Sh. E.	About bisected	6 9 54·4	20 55 34·1	21 0	—	“
169				Limb complete	6 11 25·4	20 57 5·1	—	—	“
170	Aug. 13, 9·27	T	II. Tr. I.	External contact	9 24 38·6	0 10 18·3	0 11	—	“
171				About bisected	9 27 12·1	0 12 51·8	—	—	“
172				Internal contact	9 30 13·1	0 15 52·8	—	—	“
173	Aug. 15, 8·35	T	II. Ec. R.	First seen	8 35 8·1	23 20 47·8	23 22 25	+ 1 37	“
174				About full blaze	8 40 30·6	23 26 10·3	—	—	“
175	Aug. 16, 7·10	T	III. Tr. E.	Internal contact	7 6 7·5	21 51 47·2	22 1	—	“
176				About bisected	7 8 48·5	21 54 28·2	—	—	“
177				External contact	7 12 37·5	21 58 17·2	—	—	“
178	“ 9·0	T	III. Sh. I.	First seen	8 56 55·8	23 42 35·5	23 45	—	“
179				About bisected	8 59 35·3	23 45 15·0	—	—	“
180				Internal contact	9 5 27·3	23 51 7·0	—	—	“
181	“ 10·16	T	I. Tr. I.	External contact	10 13 22·2	0 59 1·9	1 2	—	“
182				About bisected	10 15 40·2	1 1 19·9	—	—	“
183				Internal contact	10 18 19·7	1 3 59·4	—	—	“
184	“ 11·25	T	I. Sh. I.	First seen	11 22 38·5	2 8 18·2	2 9	—	300
185				About bisected	11 25 0·0	2 10 39·7	—	—	“
186				Internal contact	11 26 59·5	2 12 39·2	—	—	“

187	Aug. 23, 10·53	T	III. Tr. E.	Internal contact	10 48 8·6	1 33 48·3	1 44	—	200
188				About bisected	10 51 34·1	1 37 13·8	—	—	“
189				External contact	10 56 17·1	1 41 56·8	—	—	“
190	Aug. 25, 7·50	T	I. Sh. I.	Limb indented	7 47 41·5	22 33 21·2	22 34	—	“
191				About bisected	7 48 32·5	22 34 12·2	—	—	“
192				Internal contact	7 50 14·5	22 35 54·2	—	—	“
193	“ 10·0	T	I. Sh. E.	Internal contact	9 57 15·7	0 42 55·4	0 50	—	“
194				About bisected	9 58 36·7	0 44 16·4	—	—	“
195				Limb complete	10 0 11·2	0 45 50·9	—	—	“
196	Aug. 26, 7·23	T	I. Ec. R.	First seen	7 21 36·1	22 7 15·8	22 7 46	+ 0 30	“
197				Full blaze	7 25 10·6	22 10 50·3	—	—	“
198	Aug. 29, 8·0	T	IV. Ec. D.	—	—	—	22 37 58	—	“

REMARKS.

Ref. No.	
153	Late.
154	Not good.
155	Not good.
156 157 158	Good observations.
159 160 161	External contact very good; disappearance very exact, steady, and well defined. The occultation perfect; satellite not visible through limb. The brown belts have the hazy appearance noted on previous nights, as if covered with a thin film of cloud.
162 163 164	Planet very tremulous and ill defined.
165 166 167	Well defined; limb slightly indented when shadow first seen; the internal contact considered good.
168 169	Well defined; internal contact lost; came too late to instrument.
170 171 172	Not very well defined; external contact and bisection fair, and internal contact very good.
173 174	First seen as a mere speck; very good observation; well defined.

Ref. No.	
175	Late.
177	Very good; well defined.
178 179 180	Very good; well defined.
181 182 183	Very good; well defined.
184 185 186	Not good; definition wretched.
187 188 189	Satellite steady, but limb of planet rather tremulous.
190	Late.
192	Good; planet unsteady.
193	Very good.
196	Very good.
198	The satellite never disappeared, but was reduced to a mere speck of light, skirting margin of shadow.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1877.				h m s	h m s	h m s	m s	
153	Aug. 2, 9·49	T	I. Sh. E.	Internal contact	—	—	0 36	—	200
154				About bisected	9 46 57·0	0 32 36·7	—	—	“
155				Limb complete	9 48 15·0	0 33 54·7	—	—	“
156	“ 8, 6·0	R	II. Ec. R.	First seen	5 58 6·5	20 43 46·2	20 45 23	+ 1 37	“
157				Quite distinct	5 58 29·5	20 44 9·2	—	—	“
158				Full blaze	6 0 39·5	20 46 19·2	—	—	“
159	“ 11·20	T	I. Oc. D.	External contact	11 17 24·8	2 3 4·5	2 4	—	“
160				About bisected	11 19 11·8	2 4 51·5	—	—	“
161				Disappearance	11 21 15·8	2 6 55·5	—	—	“
162	Aug. 9, 8·26	T	I. Tr. I.	External contact	8 24 40·9	23 10 20·6	23 12	—	“
163				About bisected	8 26 51·9	25 12 31·6	—	—	“
164				Internal contact	8 28 25·9	23 14 5·6	—	—	“
165	“ 9·30	T	I. Sh. I.	First seen	9 28 17·8	0 13 57·5	0 14	—	“
166				About bisected	9 28 59·8	0 14 39·5	—	—	“
167				Internal contact	9 31 23·8	0 17 23·5	—	—	“
168	Aug. 11, 6·10	T	I. Sh. E.	About bisected	6 9 54·4	20 55 34·1	21 0	—	“
169				Limb complete	6 11 25·4	20 57 5·1	—	—	“
170	Aug. 13, 9·27	T	II. Tr. I.	External contact	9 24 38·6	0 10 18·3	0 11	—	“
171				About bisected	9 27 12·1	0 12 51·8	—	—	“
172				Internal contact	9 30 13·1	0 15 52·8	—	—	“
173	Aug. 15, 8·35	T	II. Ec. R.	First seen	8 35 8·1	23 20 47·8	23 22 25	+ 1 37	“
174				About full blaze	8 40 30·6	23 26 10·3	—	—	“
175	Aug. 16, 7·10	T	III. Tr. E.	Internal contact	7 6 7·5	21 51 47·2	22 1	—	“
176				About bisected	7 8 48·5	21 54 28·2	—	—	“
177				External contact	7 12 37·5	21 58 17·2	—	—	“
178	“ 9·0	T	III. Sh. I.	First seen	8 56 55·8	23 42 35·5	23 45	—	“
179				About bisected	8 59 35·3	23 45 15·0	—	—	“
180				Internal contact	9 5 27·3	23 51 7·0	—	—	“
181	“ 10·16	T	I. Tr. I.	External contact	10 13 22·2	0 59 1·9	1 2	—	“
182				About bisected	10 15 40·2	1 1 19·9	—	—	“
183				Internal contact	10 18 19·7	1 3 59·4	—	—	“
184	“ 11·25	T	I. Sh. I.	First seen	11 22 38·5	2 8 18·2	2 9	—	300
185				About bisected	11 25 0·0	2 10 39·7	—	—	“
186				Internal contact	11 26 59·5	2 12 39·2	—	—	“

187 188 189	Aug. 23, 10·53	T	III. Tr. E.	Internal contact About bisected External contact	10 48 8·6 10 51 34·1 10 56 17·1	1 33 48·3 1 37 13·8 1 41 56·8	1 44 — —	— — —	200 “ “
190 191 192	Aug. 25, 7·50	T	I. Sh. I.	Limb indented About bisected Internal contact	7 47 41·5 7 48 32·5 7 50 14·5	22 33 21·2 22 34 12·2 22 35 54·2	22 34 — —	— — —	“ “ “
193 194 195	“ 10·0	T	I. Sh. E.	Internal contact About bisected Limb complete	9 57 15·7 9 58 36·7 10 0 11·2	0 42 55·4 0 44 16·4 0 45 50·9	0 50 — —	— — —	“ “ “
196 197	Aug. 26, 7·23	T	I. Ec. R.	First seen Full blaze	7 21 36·1 7 25 10·6	22 7 15·8 22 10 50·3	22 7 46 —	+ 0 30 —	“ “
198	Aug. 29, 8·0	T	IV. Ec. D.	—	—	—	22 37 58	—	“

REMARKS.

Ref. No.	
153	Late.
154	Not good.
155	Not good.
156 157 158	Good observations.
159 160 161	External contact very good; disappearance very exact, steady, and well defined. The occultation perfect; satellite not visible through limb. The brown belts have the hazy appearance noted on previous nights, as if covered with a thin film of cloud.
162 163 164	Planet very tremulous and ill defined.
165 166 167	Well defined; limb slightly indented when shadow first seen; the internal contact considered good.
168 169	Well defined; internal contact lost; came too late to instrument.
170 171 172	Not very well defined; external contact and bisection fair, and internal contact very good.
173 174	First seen as a mere speck; very good observation; well defined.
175	Late.
177	Very good; well defined.
178 179 180	Very good; well defined.
181 182 183	Very good; well defined.
184 185 186	Not good; definition wretched.
187 188 189	Satellite steady, but limb of planet rather tremulous.
190	Late.
192	Good; planet unsteady.
193	Very good.
196	Very good.
198	The satellite never disappeared, but was reduced to a mere speck of light, skirting margin of shadow.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1877.				h m s	h m s	h m s	m s	
153	Aug. 2, 9·49	T	I. Sh. E.	Internal contact	—	—	0 36	—	200
154				About bisected	9 46 57·0	0 32 36·7	—	—	“
155				Limb complete	9 48 15·0	0 33 54·7	—	—	“
156	“ 8, 6·0	R	II. Ec. R.	First seen	5 58 6·5	20 43 46·2	20 45 23	+ 1 37	“
157				Quite distinct	5 58 29·5	20 44 9·2	—	—	“
158				Full blaze	6 0 39·5	20 46 19·2	—	—	“
159	“ 11·20	T	I. Oc. D.	External contact	11 17 24·8	2 3 4·5	2 4	—	“
160				About bisected	11 19 11·8	2 4 51·5	—	—	“
161				Disappearance	11 21 15·8	2 6 55·5	—	—	“
162	Aug. 9, 8·26	T	I. Tr. I.	External contact	8 24 40·9	23 10 20·6	23 12	—	“
163				About bisected	8 26 51·9	25 12 31·6	—	—	“
164				Internal contact	8 28 25·9	23 14 5·6	—	-	“
165	“ 9·30	T	I. Sh. I.	First seen	9 28 17·8	0 13 57·5	0 14	—	“
166				About bisected	9 28 59·8	0 14 39·5	—	—	“
167				Internal contact	9 31 23·8	0 17 23·5	—	—	“
168	Aug. 11, 6·10	T	I. Sh. E.	About bisected	6 9 54·4	20 55 34·1	21 0	—	“
169				Limb complete	6 11 25·4	20 57 5·1	—	—	“
170	Aug. 13, 9·27	T	II. Tr. I.	External contact	9 24 38·6	0 10 18·3	0 11	—	“
171				About bisected	9 27 12·1	0 12 51·8	—	—	“
172				Internal contact	9 30 13·1	0 15 52·8	—	—	“
173	Aug. 15, 8·35	T	II. Ec. R.	First seen	8 35 8·1	23 20 47·8	23 22 25	+ 1 37	“
174				About full blaze	8 40 30·6	23 26 10·3	—	—	“
175	Aug. 16, 7·10	T	III. Tr. E.	Internal contact	7 6 7·5	21 51 47·2	22 1	—	“
176				About bisected	7 8 48·5	21 54 28·2	—	—	“
177				External contact	7 12 37·5	21 58 17·2	—	—	“
178	“ 9·0	T	III. Sh. I.	First seen	8 56 55·8	23 42 35·5	23 45	—	“
179				About bisected	8 59 35·3	23 45 15·0	—	—	“
180				Internal contact	9 5 27·3	23 51 7·0	—	—	“
181	“ 10·16	T	I. Tr. I.	External contact	10 13 22·2	0 59 1·9	1 2	—	“
182				About bisected	10 15 40·2	1 1 19·9	—	—	“
183				Internal contact	10 18 19·7	1 3 59·4	—	—	“
184	“ 11·25	T	I. Sh. I.	First seen	11 22 38·5	2 8 18·2	2 9	—	300
185				About bisected	11 25 0·0	2 10 39·7	—	—	“
186				Internal contact	11 26 59·5	2 12 39·2	—	—	“

187 188 189	Aug. 23, 10·53	T	III. Tr. E.	Internal contact About bisected External contact	10 48 8·6 10 51 34·1 10 56 17·1	1 33 48·3 1 37 13·8 1 41 56·8	1 44 — —	— — —	200 " "
190 191 192	Aug. 25, 7·50	T	I. Sh. I.	Limb indented About bisected Internal contact	7 47 41·5 7 48 32·5 7 50 14·5	22 33 21·2 22 34 12·2 22 35 54·2	22 34 — —	— — —	" " "
193 194 195	" 10·0	T	I. Sh. E.	Internal contact About bisected Limb complete	9 57 15·7 9 58 36·7 10 0 11·2	0 42 55·4 0 44 16·4 0 45 50·9	0 50 — —	— — —	" " "
196 197	Aug. 26, 7·23	T	I. Ec. R.	First seen Full blaze	7 21 36·1 7 25 10·6	22 7 15·8 22 10 50·3	22 7 46 —	+ 0 30 —	" "
198	Aug. 29, 8·0	T	IV. Ec. D.	—	—	—	22 37 58	—	"

REMARKS.

Ref. No.	
153	Late.
154	Not good.
155	Not good.
156 157 158	Good observations.
159 160 161	External contact very good; disappearance very exact, steady, and well defined. The occultation perfect; satellite not visible through limb. The brown belts have the hazy appearance noted on previous nights, as if covered with a thin film of cloud.
162 163 164	Planet very tremulous and ill defined.
165 166 167	Well defined; limb slightly indented when shadow first seen; the internal contact considered good.
168 169	Well defined; internal contact lost; came too late to instrument.
170 171 172	Not very well defined; external contact and bisection fair, and internal contact very good.
173 174	First seen as a mere speck; very good observation; well defined.

Ref. No.	
175	Late.
177	Very good; well defined.
178 179 180	Very good; well defined.
181 182 183	Very good; well defined.
184 185 186	Not good; definition wretched.
187 188 189	Satellite steady, but limb of planet rather tremulous.
190	Late.
192	Good; planet unsteady.
193	Very good.
196	Very good.
198	The satellite never disappeared, but was reduced to a mere speck of light, skirting margin of shadow.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1877.				h m s	h m s	h m s	m s	
153	Aug. 2, 9·49	T	I. Sh. E.	Internal contact	—	—	0 36	—	200
154				About bisected	9 46 57·0	0 32 36·7	—	—	"
155				Limb complete	9 48 15·0	0 33 54·7	—	—	"
156	" 8, 6·0	R	II. Ec. R.	First seen	5 58 6·5	20 43 46·2	20 45 23	+ 1 37	"
157				Quite distinct	5 58 29·5	20 44 9·2	—	—	"
158				Full blaze	6 0 39·5	20 46 19·2	—	—	"
159	" 11·20	T	I. Oc. D.	External contact	11 17 24·8	2 3 4·5	2 4	—	"
160				About bisected	11 19 11·8	2 4 51·5	—	—	"
161				Disappearance	11 21 15·8	2 6 55·5	—	—	"
162	Aug. 9, 8·26	T	I. Tr. I.	External contact	8 24 40·9	23 10 20·6	23 12	—	"
163				About bisected	8 26 51·9	25 12 31·6	—	—	"
164				Internal contact	8 28 25·9	23 14 5·6	—	-	"
165	" 9·30	T	I. Sh. I.	First seen	9 28 17·8	0 13 57·5	0 14	—	"
166				About bisected	9 28 59·8	0 14 39·5	—	—	"
167				Internal contact	9 31 23·8	0 17 23·5	—	—	"
168	Aug. 11, 6·10	T	I. Sh. E.	About bisected	6 9 54·4	20 55 34·1	21 0	—	"
169				Limb complete	6 11 25·4	20 57 5·1	—	—	"
170	Aug. 13, 9·27	T	II. Tr. I.	External contact	9 24 38·6	0 10 18·3	0 11	—	"
171				About bisected	9 27 12·1	0 12 51·8	—	—	"
172				Internal contact	9 30 13·1	0 15 52·8	—	—	"
173	Aug. 15, 8·35	T	II. Ec. R.	First seen	8 35 8·1	23 20 47·8	23 22 25	+ 1 37	"
174				About full blaze	8 40 30·6	23 26 10·3	—	—	"
175	Aug. 16, 7·10	T	III. Tr. E.	Internal contact	7 6 7·5	21 51 47·2	22 1	—	"
176				About bisected	7 8 48·5	21 54 28·2	—	—	"
177				External contact	7 12 37·5	21 58 17·2	—	—	"
178	" 9·0	T	III. Sh. I.	First seen	8 56 55·8	23 42 35·5	23 45	—	"
179				About bisected	8 59 35·3	23 45 15·0	—	—	"
180				Internal contact	9 5 27·3	23 51 7·0	—	—	"
181	" 10·16	T	I. Tr. I.	External contact	10 13 22·2	0 59 1·9	1 2	—	"
182				About bisected	10 15 40·2	1 1 19·9	—	—	"
183				Internal contact	10 18 19·7	1 3 59·4	—	—	"
184	" 11·25	T	I. Sh. I.	First seen	11 22 38·5	2 8 18·2	2 9	—	300
185				About bisected	11 25 0·0	2 10 39·7	—	—	"
186				Internal contact	11 26 59·5	2 12 39·2	—	—	"

187 188 189	Aug. 23, 10·53	T	III. Tr. E.	Internal contact About bisected External contact	10 48 8·6 10 51 34·1 10 56 17·1	1 33 48·3 1 37 13·8 1 41 56·8	1 44 — —	— — —	200 “ “
190 191 192	Aug. 25, 7·50	T	I. Sh. I.	Limb indented About bisected Internal contact	7 47 41·5 7 48 32·5 7 50 14·5	22 33 21·2 22 34 12·2 22 35 54·2	22 34 — —	— — —	“ “ “
193 194 195	“ 10·0	T	I. Sh. E.	Internal contact About bisected Limb complete	9 57 15·7 9 58 36·7 10 0 11·2	0 42 55·4 0 44 16·4 0 45 50·9	0 50 — —	— — —	“ “ “
196 197	Aug. 26, 7·23	T	I. Ec. R.	First seen Full blaze	7 21 36·1 7 25 10·6	22 7 15·8 22 10 50·3	22 7 46 —	+ 0 30 —	“ “
198	Aug. 29, 8·0	T	IV. Ec. D.	—	—	—	22 37 58	—	“

REMARKS.

Ref. No.	
153	Late.
154	Not good.
155	Not good.
156 157 158	Good observations.
159 160 161	External contact very good; disappearance very exact, steady, and well defined. The occultation perfect; satellite not visible through limb. The brown belts have the hazy appearance noted on previous nights, as if covered with a thin film of cloud.
162 163 164	Planet very tremulous and ill defined.
165 166 167	Well defined; limb slightly indented when shadow first seen; the internal contact considered good.
168 169	Well defined; internal contact lost; came too late to instrument.
170 171 172	Not very well defined; external contact and bisection fair, and internal contact very good.
173 174	First seen as a mere speck; very good observation; well defined.

Ref. No.	
175	Late.
177	Very good; well defined.
178 179 180	Very good; well defined.
181 182 183	Very good; well defined.
184 185 186	Not good; definition wretched.
187 188 189	Satellite steady, but limb of planet rather tremulous.
190	Late.
192	Good; planet unsteady.
193	Very good.
196	Very good.
198	The satellite never disappeared, but was reduced to a mere speck of light, skirting margin of shadow.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date and Time.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1877.				h m s	h m s	h m s	m s	
199	Aug. 29 8·32	R	II. Oc. D.	External contact	8 29 2·1	23 14 41·8	23 18	—	200
200				About bisected	8 31 6·1	23 16 45·8	—	—	"
201				Internal contact	8 33 59·9	23 19 39·6	—	—	"
202	Oct. 2, 7·55	T	I. Oc. D.	External contact	7 53 8·4	23 38 48·1	22 41	—	"
203				About bisected	7 54 53·4	22 40 33·1	—	—	"
204				Disappearance	7 56 51·4	22 42 31·1	—	—	"
205	Oct. 10. 8·20	T	I. Sh. I.	External contact	—	—	23 4	—	125
206				Bisected	8 19 6·0	23 4 45·7	—	—	"
207				Internal contact	8 20 58·0	23 6 37·7	—	—	"
208	" 9·23	T	I. Tr. E.	Internal contact	9 20 48·8	0 6 28·8	0 8	—	"
209				External contact	9 24 55·8	0 10 35·5	—	—	"
210	Oct. 11, 7·50	R	I. Ec. R.	First seen	7 49 31·8	22 35 11·5	22 35 22	+ 0 10	200
211				Full blaze	7 51 6·8	22 36 46·5	—	—	"
212	Oct. 23, 9·25	T	III. Oc. R.	First seen	9 25 20·6	0 11 0·3	0 17	—	"
213				About bisected	9 30 28·6	0 16 8·3	—	—	"
214				Full blaze	9 37 22·6	0 23 2·3	—	—	"
215	Nov. 4, 7·47	T	IV. Ec. D.	Half in shade	7 30 44·3	22 16 24·0	22 26 30	– 5 45	"
216				Excessively faint	7 44 14·3	22 29 54·0	—	—	"
217				Still visible	7 46 14·3	22 31 54·0	—	—	"
218				Disappeared	7 46 35·8	22 32 15·5	—	—	"

REMARKS.

Ref. No.	
199 Good 200 201 Good	Good; planet well defined and steady. The satellite disappeared behind the south dark belt, but was visible through limb for about a minute after noted time of internal contact.
202 203 204	Not very good; planet ill defined and unsteady; shadow of second satellite indistinct.
205	Lost.
206 207	Very good.
208 209	Wretchedly defined.
210 211	Planet very unsteady, and ill defined; satellite, when first seen, quite distinct.
212 213 214	Supposed to be a little late. When the satellite was first seen it was visibly separated from the limb or edge of planet, which, however, was not very well defined.
215 216 217 218	Good; very steady. Planet and satellites beautifully defined; discs of latter distinctly visible. Progress of eclipse closely watched, and the instant of disappearance considered very exact.

June 30th, 8h.—Looked at Jupiter. A black circular indentation on the edge of the bright belt, darker than the adjacent dark belt. The bright equatorial belt is much broken up, and the two dark belts, especially the southern one, are marked by well-defined bright streaks; the planet, however, was not very well defined.—T.

July 2nd, 8—9h.—The equatorial bright belt appeared less dense and narrower than as seen on the 30th June, as though breaking up, especially near the meridian, where it was encroached upon by the dark belt to the south. The long narrow bright streak of cloud noticed on the 30th, on the south dark band still visible, and certainly broader and better defined, extending from the east limb about three-quarters across the planet, tapering towards the west, and having its base resting on the east edge of planet, where it merged into the bright equatorial belt. Several remarkable darkish spots on the dark belts were visible, one near the western limb being the most marked; it was situated on the southern verge of the southern dark belt, and, to the east of it, the adjoining southerly bright belt rose as a sharp bluff, like a cumulus cloud, as shown in the drawing; on the east side of the axis in the same belt, and to the south of the narrow bright streak before mentioned, was another dark spot; on the dark belt north of the equator, and to the east of the meridian, were several other darkish spots, of which the eastern one was the largest, and this at times appeared to extend partly across the equatorial bright belt, giving one the idea, as it appeared and disappeared (owing probably to the variable definition or distinctness of the planet), of a flitting shadow, having apparently a pulsatory movement across the equatorial belt. The dark belts do not appear to me to be so bright, or to have the same metallic lustre, as last year, being of a burnt sienna color, and hazy. The drawing taken to-night is about 9½ Jovian days after that taken on the 28th June.—T.

July 5th, 9h.—Planet and satellites well defined; with powers of 300 and 660, both Mr. Ringwood and myself felt certain we saw a spot or mark near the centre of the third satellite.—T.

August 2nd, 8·10.—The definition good, but the planet had the appearance as if it was covered with a haze or fog; the clouds are not so brilliantly white, and the brown belts not so bright, and lack the metallic lustre of last year. In the sketch (which is taken about 75 Jovian days after that of the 2nd July), there is shown a dark copper-colored streak along the southern margin of the south brown belt, butting on to a bluff-headed streak of cumulus cloud, which may be the same remarkable bluff head noticed on July 2nd. The north brown belt has a few scattered clouds in front of the shadow of the first satellite, as shown in the drawing. At 8·15 it was noticed for the first time that there was a *faint* streak of cloud along the centre of the south dark band—perhaps the remnant of the narrow streak so prominent on the 2nd July.—T. and R.

October 23rd, 9·25.—At the occultation reappearance of the third satellite, when first seen it was sensibly separated from the limb or edge of planet, which, however, was not very well defined.—T.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. East. || LATITUDE, 34° 56′ 38·5″ South.

1878.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
					h m s	h m s	h m s	m s	
1	July 5.............	T	IV. Sh.E.	About bisected	10 0 32·31	0 46 12·01	—	—	200
2			IV. Tr. I.	External contact	10 5 7·30	0 50 47·00	—	—	"
3			IV. Sh. E.	Disappeared	10 5 22·30	0 51 2·00	—	—	"
4			IV. Tr. I.	Bisected	10 12 24·29	0 58 3·99	—	—	"
5			IV. Tr. I.	Internal contact	10 16 49·28	1 2 28·98	—	—	"
6	July 7	T	I. Oc. R.	First seen	8 36 17·77	23 21 57·47	—	—	"
7				About bisected	8 36 37·77	23 22 17·47	—	—	"
8				External contact	8 39 7·77	23 24 47·47	—	—	"
9	July 21	T	I. Ec. D.	Disappearance	9 43 31·36	0 29 11·06	0 28 45	− 0 26	"
10	July 22	T	I. Sh. E.	Internal contact	9 5 0·06	23 50 39·76	—	—	"
11				About bisected	9 8 53·55	23 54 33·25	—	—	"
12				Limb complete	9 9 49·55	23 55 29·25	—	—	"
13	July 22	T	I. Tr. E.	Internal contact	9 10 36·55	23 56 16·25	—	—	"
14				Bisection	9 12 37·05	23 58 16·75	—	—	"
15				External contact	9 15 38·05	0 1 17·75	—	—	"
16	July 22	T	II. Ec. D.	Last seen	10 31 18·95	1 16 58·65	1 16 3	+ 0 4	"
17	July 23	T	I. Oc. R.	External contact	6 38 12·50	21 23 52·20	—	—	"
18	July 26	T	III. Tr. I.	External contact	8 14 0·35	22 59 40·05	—	—	"
19				Bisected	8 19 13·35	23 4 53·05	—	—	"
20				Internal contact	8 23 58·35	23 9 38·05	—	—	"
21	"	T	III. Sh. I.	First seen	8 28 38·25	23 14 17·95	—	—	
22				Bisected	8 29 38·25	23 15 17·95	—	—	
23				Internal contact	8 32 28·25	23 18 7·95	—	—	

24	"	R	III. Tr. E.	Bisection	11 51 57·85	2 37 37·55	—	—	"
25			III. Sh. E.	Internal contact	11 55 17·85	2 40 57·55	—	—	"
26			III. Tr. E.	External contact	11 56 7·84	2 41 47·54	—	—	"
27			III. Sh. E.	Bisected	11 56 49·34	2 42 29·04	—	—	"
28			III. Sh. E.	Limb complete	12 1 37·83	2 47 17·53	—	—	"
29	July 29	T	I. Tr. I.	External contact	8 26 26·30	23 12 6·00	—	—	"
30				Bisection	8 32 3·80	23 23 43·50	—	—	"
31				Internal contact	8 41 19·80	23 26 59·50	—	—	"
32	"	T	I. Sh. I.	First seen	8 45 54·30	23 31 34·00	—	—	"
33				About bisected	8 47 38·30	23 33 18·00	—	—	"
34				Internal contact	8 49 46·30	23 35 26·00	—	—	"
35	"	T	I. Tr. E.	Internal contact	10 54 50·00	1 40 29·70	—	—	"
36				About bisected	10 57 5·00	1 42 44·70	—	—	"
37				External contact	11 0 8·05	1 45 48·20	—	—	"

REMARKS.

Ref. No.

1 Late, clouded
2 Good ....
3 Pretty good .
4 Late, doubtful — clouds passing frequently hiding planet .
Very good ..

Observations interfered with by passing clouds, but splendid glimpses occasionally, the planet and satellites being splendidly defined; the latter, excepting the fourth, having well-defined discs; the fourth satellite, before ingress, was noticed as faint, and when on the planet's disc it appeared as a black well-defined spot on the northern white belt, almost as black as its shadow, which was then passing off the opposite limb. The transit occurred on the north bright belt.

6, 7, 8 Not good; planet very badly defined.

9 Very good, but satellite disappearing close to the limb might cause the time noted to be a little early.

10, 11, 12, 13, 14 Clouds interfering; the shadow and satellite traversed the north edge of the north equatorial white belt, and were almost touching each other.

Ref. No.

15 Very good observation.

16 Observation doubtful; clouds continually obscuring planet, which, however, emerged just before time noted, and I then caught sight of satellite as a mere speck close to, but not touching, the edge or limb of planet. The time noted was when it disappeared.

17 Late; not good, planet fearfully ill-defined and unsteady.
18 Not very good.
20 Considered good.
21 Late; clouds interfering.
23 Difficult.

28 When shadow disappeared the satellite was only about half its diameter outside the limb of the planet.

31 Satellite entered on northern edge of equatorial bright belt.
32 Limb slightly indented.

35, 36, 37 Considered good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1878.				h m s	h m s	h m s	m s	
38	July 29 …………	T	I. Sh. E.	Internal contact	11 1 4·00	1 46 43·70	—	—	200
39				About bisected	11 2 13·00	1 47 52·70	—	—	"
40				Limb complete	11 4 31·00	1 50 10·70	—	—	"
41	August 7 …………	T	I. Tr. E.	Internal contact	7 4 45·68	21 50 25·38	—	—	"
42				About bisection	7 6 58·68	21 52 38·38	—	—	"
43				External contact	7 9 0·18	21 54 39·88	—	—	"
44	August 9 …………	R	II. Ec. R.	First seen	7 48 25·60	22 34 5·30	22 34 52	+ 0 47	"
45				Full blaze	7 54 15·10	22 39 54·80	—	—	"
46	August 13 …………	T	I. Oc. D.	External contact	9 23 21·67	0 9 1·37	—	—	"
47				About bisected	9 25 12·17	0 10 51·87	—	—	"
48				Internal contact	9 27 58·67	0 13 38·37	—	—	"
49	" …………	T	III. Ec. R.	First seen	9 54 32·10	0 40 11·80	0 43 28	+ 3 16	"
50				About bisection	9 58 49·10	0 44 28·80	—	—	"
51				Full blaze	10 1 59·10	0 47 38·80	—	—	"
52	" …………	T	I. Ec. R.	First seen	12 12 0·80	2 57 40·50	2 57 48	+ 0 7	"
53				Full blaze	12 16 33·80	3 2 13·50	—	—	"
54	August 21 …………	T	I. Tr. I.	External contact	8 16 25·80	23 2 5·50	—	—	"
55				About bisected	8 19 22·30	23 5 2·00	—	—	"
56				Internal contact	8 22 2·78	23 7 42·48	—	—	"
57	" …………	T	I. Sh. I.	First seen	8 58 55·20	23 44 34·90	—	—	"
58				Bisected	8 59 29·70	23 45 9·40	—	—	"
59				Internal contact	9 1 33·70	23 47 13·40	—	—	"
60	September 25 ………	T	III. Ec. R.	First seen	10 0 21·38	0 46 1·08	0 49 40	+ 3 39	"
61				Full blaze	10 12 38·38	0 58 18·08	—	—	"
62	" ………	T	I. Ec. R.	First seen	7 9 57·13	21 55 36·83	21 55 50	+ 0 13	"
63				Full blaze	7 13 7·63	21 58 47·33	—		"

64	October 1..........	T	I. Oc. D.	External contact	9 53 25·20	0 39 4·90	—		"
65				About bisected	9 55 28·20	0 41 7·90	—	—	"
66				Internal contact	9 57 49·20	0 43 28·90	—	—	"
67	October 2..........	T	III. Oc. R.	First seen	9 54 39·30	0 40 19·00	—	—	"
68				About bisection	9 57 28·30	0 43 8·00	—	—	"
69				External contact	10 1 34·30	0 47 14·00	—	—	"
70	"	T	III. Ec. D.	Disappearance	10 34 47·50	1 20 27·20	1 20 52	+ 0 25	"
71	October 5	T	IV. Ec. D.	Minute speck	8 20 38·62	23 6 18·32	23 10 19	+ 2 2	"
72				Still visible	8 22 15·12	23 7 54·82	—	—	"
73				Disappearance	8 22 37·62	23 8 17·32	—	—	"
74	October 21..........	T	I. Oc. D.	External contact	9 16 19·54	0 1 59·24	—	—	"
75				About bisected	9 17 55·54	0 3 35·24	—	—	"
76				Disappeared	9 20 34·04	0 6 13·74	—	—	"
77	October 23..........	R	I. Ec. R.	First seen	7 25 4·46	22 10 44·16	22 10 46	+ 0 2	"
78				Quite distinct	7 25 19·96	22 10 59·66	—	—	"
79				Full blaze	7 27 48·96	22 13 28·66	—	—	"

REMARKS.

Ref. No.	
39	Appearing as a cup to satellite.
41 42 43	Definition wretched; planet very unsteady, limb boiling; lost egress of shadow by clouds.
44	Very exact, seen instantly; definition good.
46 47 48	Very exact; planet and satellite very well defined; occultation complete at limb; satellite disappeared behind bright equatorial belt, and a little south of the equator.
49 50 51	Definition splendid, satellite well defined, and at time noted of bisection it appeared as a half-moon.
54	Not very good; planet unsteady.
56	Very good.
57	Late; limb indented.
58 59	Good observations.
62 63	Good observations, well defined; first seen as a minute speck of light.

Ref. No.	
64 65 66	All good; satellite disappeared behind equatorial cloudbelt.
68	Too soon; emerged from behind southern dark band, near its polar margin, and slightly separated from limb; observations considered good, but planet not well defined, except in glimpses.
70	Very good and exact; fourth satellite very faint.
73	Considered exact, but lost sight of satellite several times before final disappearance; planet not well defined; moon a little to east of planet.
74 75 76	Very badly defined, but observations pretty good; at times I thought satellite could be seen through edge of planet, but not certain.
77	Good, sharp, and exact; definition of planet fair.
78	As distinct as a small star, to the north, between two satellites to the east of No. I.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date. 1878.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time. h m s	Corresponding Greenwich Mean Time. h m s	Time by *Nautical Almanac.* h m s	Apparent Error of *Nautical Almanac.* m s	Power.
80	October 28..........	T	I. Oc. D.	External contact	11 13 8·22	1 58 47·92	—	—	200
81				About bisected	11 14 38·22	2 0 17·92	—	—	"
82				Last seen	11 16 23·22	2 2 2·92	—	—	"
83	November 7	R	IV. Oc. D.	External contact	8 34 29·72	23 20 9·42	—	—	300
84				About bisected	8 37 33·22	23 23 12·92	—	—	"
85				Seen through limb	8 39 22·71	23 25 2·41	—	—	"
86				Seen through limb	8 40 24·71	23 26 4·41	—	—	"
87				Seen through limb	8 41 38·20	23 27 17·90	—	—	"
88				Internal contact	8 41 54·69	23 27 34·39	—	—	"
89				Last seen	8 41 59·69	23 17 39·39	—	—	"
90	"	R	III. Ec. R.	First seen	10 8 33·53	0 54 13·23	0 57 39	+ 3 25	200
91				Quite distinct	10 9 27·03	0 55 6·73	—	—	"
92				As bright as adjoining Sat. No. II.	10 12 39·53	0 58 19·23	—	—	"
93				Full blaze	10 15 0·52	1 0 40·22	—	—	"
94	November 13	T	I. Oc. D.	External contact	9 34 58·15	0 20 37·85	—	—	"
95				About bisected	9 36 51·15	0 22 30·85	—	—	"
96				Internal contact	9 38 55·15	0 24 34·85	—	—	"
97	November 15	R	I. Ec. R.	First seen	7 39 43·23	22 25 22·93	22 25 28	+ 0 5	"
98				Quite distinct	7 40 4·23	22 25 43·93	—	—	"
99				Full blaze	7 42 7·23	22 27 46·93	—	—	"
100	December 11	T	IV. Ec. D.	Disappearance	9 0 14·80	23 45 54·50	23 49 3	+ 3 8	125

REMARKS.

Ref. No.	
80 81 82	Not very good; badly defined and very unsteady.
83	May be a little too soon.
88	Satellite passed behind white cloudbelt at about lat. 25° or 30° S.
89	Fancied I saw it at 5s. after internal contact, but not very certain; definition good and steady. Looked for egress of shadow of first satellite, but could not see it.
90	Very minute speck of light; caught the first glimpse. Very good observation.
91 92 93	Very good observations.
94 95 96	Mere guesswork; planet and satellites most wretchedly defined.
97 98 99	Not considered first-rate; hazy, and definition bad.
100	Very good; a mere speck for last minute or more; planet dreadfully ill defined.

NOTES ON THE PHYSICAL APPEARANCE OF JUPITER, ETC.

July 5th, 10·25 p.m.—North of the equatorial belt was a well-defined streak, of dark-salmon color; the dark belt on the south of the equator was covered with scattered white-looking clouds, to the south of which was a bright belt, having a remarkable bright spot—like a cumulus cloud—on the southern edge, on the meridian, to the east of which, at some distance, was a well-defined rectangular indentation.—T.

July 21st, 9·45 p.m.—The appearance of the salmon-colored streak was as if viewed through a thin veil of cloud. On the south edge of the equatorial cloudbelt was an oval brilliantly-white cloud, nearly on the equator and exactly mid-planet.—T.

July 26th, 8·35 p.m.—At three minutes after Observation No. 23 the shadow was about its own diameter inside the limb of planet and immediately following the satellite; in fact, touching it to all appearance. The satellite entered on the dark band north of the equator, the central portions of which were of a bright sienna, or nearly rose color. The equatorial cloudbelt was generally diffused, but its central parts were very dense, having the appearance and shape of cumulus clouds. The dark belts have still that appearance as if seen through hazy cloud or fog. The satellite when it first entered planet appeared large and bright, but became gradually smaller—still bright—and the shadow seemed larger than the satellite.—R.

July 29th, 8·35 p.m.—The equatorial belt is not so broad or so well defined as usual, and consists of comparatively narrow streaks of broken cloud—of cumulus form on southern edge; the northern dark belt is not at all well marked, and is more of a rosy-salmon color, especially on the north side; the southern dark belt is broken by streaks of white cloud, and is not so well marked or defined, although broader than the northern belt, and is less highly colored.—T.

July 29th, 10·50 p.m.—No. I. satellite and its shadow traversing the north portion of the equatorial belt, and almost touching each other—the shadow a little to the north of satellite, the south pole of the shadow being in line with the equator of the satellite. The equatorial belt is broader than before, and the north brown belt darker; the southern dark belt is broken by a white streak, stretching nearly across the planet, and is hazy and not so red, or brown, as the north belt.—T.

August 9th, 7·50 p.m.—Jupiter well defined. The long, oval, dark-reddish patch south of the southern belt, noticed on the 4th, still visible, but I think slightly longer. The bright patch on bright belt not distinguishable.—T.

August 13th, 10·0 p.m.—The oval red space on southern bright belt, noted on the 4th, still visible, but not the bright spot on the equatorial cloudbelt, but a bright spot very like it precedes it several Jovian hours, being near the western edge of the planet when the red space was rather more than half visible on the opposite or eastern side of the planet.—T.

October 1st, 10·0 p.m.—The equatorial cloudbelt was dense, and the occultation was complete at limb. It may be here remarked, as a general note, that the satellites as a rule are not visible through the dense white cloudbelts, but are seen at occultation through the broken cloudbelts and brown belts.—T.

October 2nd, 10·0 p.m.—The southern dark belt this year has generally been covered with a thin film of white cloud, and has seldom the decided salmon tint noticed in previous years—occasionally assuming a greyish-green. The equatorial bright belt to-night resembled a bank of cumulus cloud, with its base toward the north and its crest toward the south. The northern dark belt is narrow, and of a salmon tint varied by dark streaks and patches.—T.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. East. ‖ **LATITUDE. 34° 35′ 38·5″ South.**

1879.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
					h m s	h m s	h m s	m s	
1	September 10	R	I. Oc. D.	Internal contact	7 39 28·9	22 25 8·6	—	—	200
2				Bisection	7 40 31·4	22 26 11·1	—	—	"
3				Last seen	7 41 46·9	22 27 26·6	—	—	"
4	"	R	I. Ec. R.	First seen	10 12 11·2	0 57 50·9	0 58 3	+ 0 12	"
5				Quite distinct	10 12 29·7	0 58 9·4	—	—	"
6				Full blaze	10 14 33·2	1 0 12·9	—	—	"
7	September 26	R	I. Ec. R.	First seen	8 31 37·6	23 17 17·3	23 17 24	+ 0 7	300
8				Quite distinct	8 31 42·6	23 17 22·3	—	—	"
9				Full blaze	8 37 22·6	23 23 2·3	—	—	"
10	October 3	T	I. Oc. D.	External contact	7 20 47·9	22 6 27·6	—	—	"
11				Bisection	7 22 18·4	22 7 58·1	—	—	"
12				External contact	7 24 19·9	22 9 59·6	—	—	"
13	"	T	I. Ec. R.	First seen	10 26 58·5	1 12 38·2	1 12 52	+ 0 14	"
14				Quite distinct	10 27 41·5	1 13 21·2	—	—	"
15				Full blaze	10 32 11·5	1 17 51·2	—	—	"
16	October 13..........	T	II. Ec. R.	First seen	9 24 18·4	0 9 58·1	0 11 8	+ 1 10	200
17				Quite distinct	9 24 49·4	0 10 29·1	—	—	"
18				Full blaze	9 29 44·4	0 15 24·1	—	—	"
19	October 17..........	T	III. Ec. D.	Very faint	7 12 42·3	21 58 22·0	21 59 43	+ 0 59	"
20				Disappeared	7 13 3·8	21 58 43·5	—	—	"
21	October 25..........	T	I. Tr. I.	External contact	9 57 1·3	0 42 41·0	—	—	"
22				Nearly bisected	9 58 3·8	0 43 43·5	—	—	"
23				Internal contact	10 0 33·3	0 46 13·0	—	—	"
24	"	T	I. Sh. I.	First seen	11 8 23·2	1 54 2·9	—	—	"
25				Internal contact	11 10 44·2	1 56 23·9	—	—	"
26	"	T	IV. Oc. R.	First seen	11 55 25·0	2 41 4·7	—	—	"
27				Bisected	11 58 12·5	2 43 52·2	—	—	"
28				External contact	12 2 19·5	2 47 59·2	—	—	"
29	"	T	I. Tr. E.	Internal contact	12 12 33·5	2 58 13·2	—	—	"
30				Bisection	12 14 20·5	3 0 0·2	—	—	"
31				External contact	12 16 33·0	3 3 12·7	—	—	"

32	October 31..........	T	III. Oc. D.	External contact	10 5 32·3	0 51 12·0	—	—	“
33				About bisected	10 9 35·3	0 55 15·0	—	—	‘
34				Internal contact	10 14 27·3	1 0 7·0	—	—	“
35	December 10	T	I. Tr. I.	External contact	10 16 59·0	1 2 38·7	—	—	“
36				About bisected	10 18 22·7	1 4 2·4	—	—	“
37				Internal contact	10 20 49·4	1 6 29·1	—	—	“

REMARKS.

Ref. No.	
1 2 3	Not good, very jumpy; definition bad.
4 5 6	Mere speck of light when first seen, close to edge of planet; definition splendid.
7	Definition good; may be a little late; moonlight.
10 11 12	Definition good, occultation complete at limb; disappeared at northern edge of equatorial belt.
13 14 15	Good and well defined; not very certain about when first seen.
16	Very exact.
19 20	Definition good.

Ref. No.	
24	Nearly bisected when first seen.
26	May be a little late; slightly projecting when first seen.
28	Fair contact; not very sharply defined and rather unsteady.
29	Good.
31	Good; planet fairly defined.
34	The occultation appeared perfect at limb, but from five to two minutes before final disappearance, Mr. Ringwood and myself felt confident we saw flashes of it well or wholly within the limb; planet was at times ill-defined, but sharply defined during occasional glimpses, and it was at these times that the satellite was thought to be seen. It disappeared behind the northern white cloudbelt and a few degrees from its southern edge.
35 36 37	Not very good, definition bad; the red spot on western limb of planet.

NOTES ON THE PHYSICAL APPEARANCE OF JUPITER.

September 10th, 9·45.—North edge of dark equatorial belt well defined and darker than the rest. To the south of the equator the band was covered with what looked like broken, scattered clouds of cumulus formation, more spread out on the east edge, and tapering towards the western wing, and they almost touched or rested upon the white south band, in which was a large oval opening, through which was seen the dark copper color beneath. It had all the appearance of a hole in the cloudbelt, and round the edge of which the clouds seemed to thin off. At each pole the planet had a pale orange tinge.—R.

October 10th, 7·30.—The definition was good, and the occultation of the first satellite was complete, disappearing at the northern edge of the equatorial belt, the ground of which was of a darkish salmon tint, more or less covered with white clouds, some of cumulus shape; the northern edge of the equatorial dark band was sharp and well defined, the southern rugged, and mixed with the south white cloudbelt.—T.

October 25th, 10·0.—There is an oval red cloud on edge of planet south of equatorial belt, and the northern edge of the equatorial belt is well defined.—T.

October 25th, 12·0.—The red elongated spot is now nearly on meridian. The equatorial belt is wide, having a reddish-black background, “the north end of which is well defined,” varied by white clouds over its southern half. The red elongated cloud to the south of this belt is of a darker color than the belt.—T.

December 10th, 10·20.—The red spot on western limb of planet.—T.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory South Australia.

Longitude, 9h. 14m. 20·3s. East. || **Latitude, 34° 56′ 38·5″ South.**

1880.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
					h m s	h m s	h m s	m s	
1 2 3	October 13..........	T	II. Oc. D.	External contact Bisected Disappearance	8 58 59·2 9 0 27·2 9 3 34·7	23 44 38·9 23 46 6·9 23 49 14·4	— — —	— — —	120 “ “
4 5 6	“	T	III. Sh. E.	Internal contact Bisected Limb complete	9 6 1·2 9 11 50·2 9 21 6·2	23 51 40·9 23 57 29·9 0 6 45·9	— — —	— — —	“ “ “
7 8 9	“	T	I. Tr. I.	First contact Bisected Internal contact	10 37 13·8 10 39 30·3 10 42 22·3	1 22 53·5 1 25 10·0 1 28 2·0	— — —	— — —	“ “ “
10 11 12	“	T	I. Sh. I.	First seen Bisected Internal contact	10 50 13·8 10 52 19·8 10 55 17·8	1 35 53·5 1 37 59·5 1 40 57·5	— — —	— — —	“ “ “
13 14 15	October 14..........	T	I. Oc. D.	External contact About bisected Internal contact	7 48 45·1 7 50 22·1 7 53 0·6	22 34 24·8 22 36 1·8 22 38 40·3	— — —	— — —	“ “ “
16 17 18	“	T	I. Ec. R.	First seen Quite distinct Full blaze	10 14 16·7 10 15 18·7 10 19 16·7	0 59 56·4 1 0 58·4 1 4 56·4	1 0 21 — —	+ 0 25 — —	200 “ “
19 20 21	October 29..........	R	II. Tr. I.	External contact Bisected Internal contact	8 1 7·5 8 3 43·1 8 6 20·3	22 46 47·2 22 49 22·8 22 52 0·0	— — —	— — —	300 “ “
22 23 24	“	R	I. Tr. I.	External contact About bisected Internal contact	8 33 30·4 8 35 1·4 8 37 32·6	23 19 10·1 23 20 41·1 23 23 12·3	— — —	— — —	“ “ “
25 26	“	R	I. Sh. I.	First seen Limb complete	9 8 2·2 9 9 53·7	23 53 41·9 23 55 33·4	— —	— —	“ “

27	“	R	II. Sh. I.	First seen	9 11 54·2	23 57 33·9	—	—	
28				About bisected	9 12 15·7	23 57 55·4	—	—	‘
29				Limb complete	9 13 7·1	23 58 46·8	—	—	“
30	“	T	I. Tr. E.	Internal contact	10 35 59·6	1 21 39·3	—	—	“
31				About bisected	10 37 24·6	1 23 4·3	—	—	“
32				External contact	10 39 26·6	1 25 6·3	—	—	“
33	“	T	II. Tr. E.	Internal contact	10 43 24·6	1 29 4·3	—	—	“
34				About bisected	10 44 56·6	1 30 36·3	—	—	“
35				External contact	10 47 1·6	1 32 41·3	—	—	“
36	November 13	R	I. Oc. D.	External contact	9 17 46·1	0 3 25·8	—	—	“
37				About bisected	9 19 44·1	0 5 23·8	—	—	“
38				Last seen	9 21 41·6	0 7 21·3	—	—	“
39	November 29	R	I. Ec. R.	First seen	10 45 39·7	1 31 19·4	1 31 50	+ 0 31	200
40				Quite distinct	10 46 24·7	1 32 4·4	—	—	“
41				Full blaze	10 50 4·7	1 35 44·4	—	—	“
42	November 30	R	II. Tr. E.	Internal contact	9 19 10·6	0 4 50·3	—	—	“
43				About bisected	9 22 10·6	0 7 50·3	—	—	“
44				External contact	9 25 15·6	0 10 55·3	—	—	“
45	December 6th	T	I. Oc. D.	External contact	9 13 21·0	23 59 0·7	—	—	“
46				About bisected	9 15 3·0	0 0 42·7	—	—	“
47				Last seen	9 17 21·0	0 3 0·7	—	—	“

REMARKS.

Ref. No.
1 Uncertain.
3 Not good; planet and satellite very badly defined.
4 Good observation.
10 Limb indented.
12 Very fair observation.

16
17 Definition very bad.
18

19
20 Good, and fairly defined.
21

22
23 Not very well defined, but observations considered fair. Satellite entered near north edge of south white cloudbelt; red spot half out of view; cannot see second satellite.
24

25 Not good; limb broken.
26 Good.
27 Not good.

Ref. No.
29 Considered good. The two shadows appear plumb to the equator, and are separated from each other by about one and three-quarters diameters, that of the second satellite being nearer the south pole.

33
34 Doubtful; seen through cloud.
35

36
37 Occulted behind dense white cloudbelt; definition splendid, sharp, and well defined, *vide* physical appearance.
38

39
40 Observations fair, but not very steady.
41

42
43 Very good definition, but uncertain to one second in time.
44

45
46 Very good.
47

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES. ETC.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Greenwich Mean Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
	1880.				h m s	h m s	h m s	m s	
48	December 9.........	T	II. Ec. R.	First seen	8 40 55·7	23 26 35·4	23 28 21	+ 1 46	300
49				Quite distinct	8 41 7·2	23 26 46·9	—	—	"
50				Full blaze	8 46 22·2	23 32 1·9	—	—	"
51	December 20.........	T	III. Ec. R.	First glimpse	11 15 38·4	2 1 18·1	2 5 49	+ 4 31	200
52				Quite distinct	11 15 57·9	2 1 37·6	—	—	"
53				Full blaze	11 25 22·9	2 11 2·6	—	—	"
54	December 22.........	T	I. Ec. R.	First seen	11 2 39·1	1 48 18·8	1 48 33	+ 0 14	"
55				Quite distinct	11 2 54·6	1 48 34·3	—	—	"
56				Full blaze	11 5 9·6	1 50 49·3	—	—	"
57	December 23.........	T	II. Oc. D.	External contact	8 36 5·0	23 21 44·7	—	—	"
58				About bisected	8 38 22·5	23 24 2·2	—	—	"
59				Internal contact	8 40 43·0	23 26 22·7	—	—	"
60	December 29.........	R	I. Oc. D.	External contact	9 23 1·4	0 8 41·1	—	—	"
61				Bisection	9 25 7·4	0 10 47·1	—	—	"
62				Internal contact	9 26 54·4	0 12 34·1	—	—	"
63				Last seen	9 27 25·4	0 13 5·1	—	—	"

REMARKS.

Ref. No.	
51	Good; well seen.
53	Very uncertain.
54 55 56	Considered good, but sky misty.

Ref. No.	
57 58 59	Observations considered good; definition good at times.
57	May be a better contact occurred at 1m. 49s. after this.
62	Seen plainly and distinctly through limb of planet; no doubt in the least, definition good, and sharply defined.

October 13th, 9h.—The second satellite disappeared to the north of the dark equatorial band behind a white cloudbelt. The equatorial band is divided by a narrow streak of white cloud, dividing it in two, the northern one being the broader; and the southern portion has scattered clouds over it on its east and west margins.—T.

October 14th, 7h. 50m.—The Great Red Spot has now wholly come in view, the eastern margin of which is almost tangential to the eastern limb of the planet. The middle portion of the bright south cloudbelt appears to be broken, there being a dark streak or shade in it, appearing as if another spot or gap were in course of formation, longer than the oval spot, and a little higher S. latitude. Yesterday evening both the north and south white cloudbelts were of an uniform brightness, without any stratification to be seen; but this evening it appears that the bright portion from the south pole towards the equator is broken up, as though some disturbance were going on. The equatorial band is of a reddish appearance, though less red than the oval spot, and is divided into two zones by a white streak of cloud.—T.

October 29th, 8h.—While observing II. Tr. I. the west end of the great red spot was passing out of view. The equatorial reddish or brown belt has a decided streak of cloud along it, denser over the equator. The north and south limits of the equatorial brown belt are well defined. The northern white cloudbelt has a decided break or crack in it, corresponding to about lat. 35° N. This break or crack is well marked across the face of the planet and in some places appears to open out more than in others.—R.

November 13th, 9·10.—The equatorial brown belt is more or less covered with thin cloud, denser in the vicinity of the equator. The northern edge of the brown belt is much better defined than the southern, and the northern white cloudbelt has the same decided break or crack running across it, in about lat. 35° N., as seen on the 29th of October. It is well marked, and appears to be more open in places. No. I. satellite occulted about its own diameter south of the crack, where the edge of the limb is sensibly indented to a depth estimated at nearly 2,000 miles. The northern portion of the equatorial brown belt is less clouded than the southern, causing that portion to be of a much darker tint than the other.—R.

December 6th, 9·15.—The west edge of the Great Oval Red Spot is just in contact with the western limb of the planet. The red equatorial belt is wider than usual and is broken by a broad band of white cloud, having the appearance of coarse cirro-cumulus; whilst in the north bright cloudbelt is a well-marked dark streak stretching across the planet, at the western extremity of which, or where it cut the limb, the satellite disappeared.—T.

December 9th, 8·40.—There is a faint crack or streak stretching across the planet in the northern white cloudbelt, being more open in places—one opening about the diameter of No. III. satellite, and three diameters in length; and the white cloudbelt has the appearance of a broad band of cumulus cloud, having its base, towards the equator, sharply defined, and the summits pointing towards the pole. The crack or streak just referred to stretches across these summits. Immediately to the north of the white cloudbelt is a faint bluish-green belt, and to the north of that again are several reddish streaks, whilst nearer the pole the planet assumes the usual greenish tint. The surface of the southern hemisphere is less varied, but the equatorial reddish band is covered with scattered clouds, more particularly over the planet's equator, overspreading nearly the whole surface, but less dense on the north side, where the band has a dark copper tint.—T.

December 22nd, 11·0.—Red spot about mid transit, scattered clouds over equatorial belt, and crack in north cloudbelt very distinct.—T.

December 23rd, 8·38.—After bisection the satellite could be distinctly seen through the apparent limb of planet. The satellite disappeared behind the north white cloudbelt, and very close to, if not at the termination of, the crack in the said belt, which appears like a bank of immense cumulus cloud resting on the equatorial brown belt, and its summits are shown by the aforesaid crack or streak, as if the dark mark was the shadow of the cloudbelt thrown on a lower layer of cloud; but the definition was not good. The equatorial belt appears to be getting more covered with clouds.—T.

December 29th, 9·25.—The equatorial belt is getting more covered with cloud, and the north white cloudbelt has become much more narrow and contracted, and the streak or crack, noticed first on the 29th of October, has now very much expanded or opened, showing a decided break to the north of the cloudbelt, extending from east to west limb of the planet. The first satellite disappeared close to the north margin of the north white cloudbelt, and could be distinctly seen through the limb till the time noted as last seen. To the south of the south cloudbelt an oval spot, similar in form and shape to the old famous spot, is to be seen about one-third of the planet's diameter from east limb, and faint belts are to be seen in high latitudes of both hemispheres.—R.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES. ETC.—*continued.*

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	1880.				h m s	h m s	h m s	m s	
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49				Quite distinct	8 41 7·2	23 26 46·9	—	—	"
50				Full blaze	8 46 22·2	23 32 1·9	—	—	"
51	December 20.........	T	III. Ec. R.	First glimpse	11 15 38·4	2 1 18·1	2 5 49	+ 4 31	200
52				Quite distinct	11 15 57·9	2 1 37·6	—	—	"
53				Full blaze	11 25 22·9	2 11 2·6	—	—	"
54	December 22.........	T	I. Ec. R.	First seen	11 2 39·1	1 48 18·8	1 48 33	+ 0 14	"
55				Quite distinct	11 2 54·6	1 48 34·3	—	—	"
56				Full blaze	11 5 9·6	1 50 49·3	—	—	"
57	December 23.........	T	II. Oc. D.	External contact	8 36 5·0	23 21 44·7	—	—	"
58				About bisected	8 38 22·5	23 24 2·2	—	—	"
59				Internal contact	8 40 43·0	23 26 22·7	—	—	"
60	December 29.........	R	I. Oc. D.	External contact	9 23 1·4	0 8 41·1	—	—	"
61				Bisection	9 25 7·4	0 10 47·1	—	—	"
62				Internal contact	9 26 54·4	0 12 34·1	—	—	"
63				Last seen	9 27 25·4	0 13 5·1	—	—	"

REMARKS.

Ref. No.	
51	Good; well seen.
53	Very uncertain.
54 55 56	Considered good, but sky misty.

Ref. No.	
57 58 59	Observations considered good; definition good at times.
57	May be a better contact occurred at 1m. 49s. after this.
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November 13th, 9·10.—The equatorial brown belt is more or less covered with thin cloud, denser in the vicinity of the equator. The northern edge of the brown belt is much better defined than the southern, and the northern white cloudbelt has the same decided break or crack running across it, in about lat. 35° N., as seen on the 29th of October. It is well marked, and appears to be more open in places. No. I. satellite occulted about its own diameter south of the crack, where the edge of the limb is sensibly indented to a depth estimated at nearly 2,000 miles. The northern portion of the equatorial brown belt is less clouded than the southern, causing that portion to be of a much darker tint than the other.—R.

December 6th, 9·15.—The west edge of the Great Oval Red Spot is just in contact with the western limb of the planet. The red equatorial belt is wider than usual and is broken by a broad band of white cloud, having the appearance of coarse cirro-cumulus; whilst in the north bright cloudbelt is a well-marked dark streak stretching across the planet, at the western extremity of which, or where it cut the limb, the satellite disappeared.—T.

December 9th, 8·40.—There is a faint crack or streak stretching across the planet in the northern white cloudbelt, being more open in places—one opening about the diameter of No. III. satellite, and three diameters in length; and the white cloudbelt has the appearance of a broad band of cumulus cloud, having its base, towards the equator, sharply defined, and the summits pointing towards the pole. The crack or streak just referred to stretches across these summits. Immediately to the north of the white cloudbelt is a faint bluish-green belt, and to the north of that again are several reddish streaks, whilst nearer the pole the planet assumes the usual greenish tint. The surface of the southern hemisphere is less varied, but the equatorial reddish band is covered with scattered clouds, more particularly over the planet's equator, overspreading nearly the whole surface, but less dense on the north side, where the band has a dark copper tint.—T.

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OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 56′ 38·5″ S.

1881.

Reference. No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power.
					h m s	h m s	h m s	m s	
1	January 14	T	III. Tr. E.	Internal contact	8 24 36·6	23 10 16·3	—	—	200
2				About bisected	8 28 10·6	23 13 50·3	—	—	“
3				External contact	8 33 1·6	23 18 41·3	—	—	“
4	January 24	R	II. Oc. D.	External contact	8 29 54·1	23 15 33 8	—	—	“
5				About bisected	8 31 44·1	23 17 23·8	—	—	“
6				Internal contact	8 34 49·1	23 20 28·8	—	—	“
7				Disappearance	8 34 54·1	23 20 33·8	—	—	“
8	January 30	R	I. Ec. R.	First seen	9 40 11·5	0 25 51·2	0 25 22	– 0 29	“
9				Quite distinct	9 40 37·5	0 26 17·2	—	—	“
10				Full blaze	9 46 55·5	0 32 35·2	—	—	“
11	February 11	T	II. Ec. R.	First seen	8 14 5·9	22 59 45·6	23 0 6	+ 0 20	“
12				Quite distinct	8 14 15·9	22 59 55·6	—	—	“
13				Full blaze	8 21 35·9	23 7 15·6	—	—	“
14	November 1	R	II. Oc. R.	First seen	9 38 1·0	0 23 40·7	—	—	
15				About bisected	9 38 28·0	0 24 7·7	—	—	
16				External contact	9 39 48·0	0 25 27·7	—	—	
17	November 10	R	I. Sh. I.	First seen	9 6 19·3	23 51 59·0	—	—	
18				Internal contact	9 7 5·9	23 52 45·6	—	—	“
19	“	R	I. Tr. I.	External contact	9 7 44·3	23 53 24 0	—	—	“
20				About bisected	9 9 37·1	23 55 16·8	—	—	“
21				Internal contact	9 11 50·1	23 57 29·8	—	—	“
22	November 29	T	III. Oc. D.	External contact	8 38 42·7	23 24 22·4	—	—	300
23				About bisected	8 45 0·7	23 30 40·4	—	—	“
24				Internal contact	8 53 48·2	23 39 27·9	—	—	“
25	December 1	T	II. Tr. I.	External contact	10 15 24·4	1 1 4·1	—	—	200
26				About bisected	10 17 42·9	1 3 22·6	—	—	“
27				Internal contact	10 20 16·9	1 5 56·6	—	—	“
28	December 2	T	I. Oc. D.	External contact	11 27 25·7	2 13 5·4	—	—	“
29				About bisected	11 29 19·2	2 14 58·9	—	—	“
30				Last seen	11 30 57·2	2 16 36·9	—	—	“

31				First seen	8 40 11·5	23 25 51·2	23 26 42	+ 0 50	"
32	December 3	T	II. Ec. R.	Full blaze	8 44 13·0	23 19 52·7	—	—	"
				External contact	8 44 38·5	23 30 18·2	—	—	"
33	"	T	I. Tr. I.	About bisected	8 46 12·5	23 31 52·2	—	—	"
34				Internal contact	8 48 5·5	23 33 45·2	—	—	"
35				First seen	9 17 23·5	0 3 2·2	—	—	"
36	"	T	I. Sh. I.	About bisected	9 18 12·0	0 3 51·7	—	—	"
37				Internal contact	9 20 50·0	0 6 29·7	—	—	"
38				Internal contact	10 54 40·1	1 40 19·8	—	—	"
39	"	T	I. Tr. E.	About bisected	10 55 49·6	1 41 29·3	—	—	"
40				External contact	10 58 9·1	1 43 48·8	—	—	"
41				Internal contact	11 23 48·6	2 9 28·3	—	—	"
42	"	T	I. Sh. E.	About bisected	11 25 14·1	2 10 53·8	—	—	"
43				Limb complete	11 27 9·6	2 12 49·3	—	—	"
44	December 11	T	I. Ec. R.	First seen	10 33 25·9	1 19 5·6	1 19 33	+ 0 27	125
45				Full blaze	10 37 32·9	1 23 12·6	—	—	"
46	December 26	R	II. Tr. E.	About bisected	9 3 59·1	23 49 38·8	—	—	200
47				External contact	9 5 38·6	23 51 18·3	—	—	"
48									

REMARKS.

Ref. No.	
1	Late; satellite not well seen.
2 3	Good, but planet not well defined.
4–7	Definition bad, but at times good; at No. 6 whole of satellite could be distinctly seen through the limb up to time of disappearance. (*Vide* Physical Appearance.)
8 9 10	Planet wretchedly defined, but observations considered good. Satellite reappeared about the semi-diameter of Jupiter from its west limb, at about 10° N. lat., and was considered to be a long time in increasing brightness—in fact, the last time noticed was not considered full illumination, which may be accounted for by a dull side of the satellite being towards the sun.
11 12 13	Pretty good observation; thin cirrus passing over sky; red spot about mid-transit.
17 18 19 20 21	Very bad throughout, definition awful, only guesswork, the satellite and its shadow touching, or apparently overlapping.

Ref. No.	
22 23 24	Definition splendid, but clouds continually passing over and obscuring planet; observations considered good.
25 26 27	Definition very bad.
28 29 30	Definition very bad, with, however, occasional good glimpses of short duration; red spot visible, but becoming overcast with thin cloud.
31	Very exact.
36 37 38	Definition very good; No. 36 a little late, limb slightly indented.
39	Little late.
41	Good.
45 46	Definition bad.
47 48	Definition bad; observations not considered good, cirri continually passing over.

NOTES ON THE PHYSICAL APPEARANCE OF JUPITER.

January 24th.—During the Oc. D of the second satellite the whole of the satellite could be distinctly seen through the limb of the planet up to the time of disappearance. The occultation occurred at about the middle of the new dark band in the north hemisphere, a band which has apparently grown out of the remarkable crack or streak in the white cloudbelt, noted for the first time on October 29th, 1880. The brown equatorial belt has a quantity of scattered clouds lying over it, but in places it has a much darker tint than others.—R.

November 1st.—The equatorial brown belt is much covered with streaks of cloud. The whole of the south temperate and polar zones seem to be of one uniform appearance. The north white cloudbelt is narrow, and has a dark band similar in color to the equatorial brown belt lying to the north, and is about the same width as the adjoining white cloudbelt; and the remainder of the north temperate zone has an uniform appearance, but the pole itself is of a brown color.—R.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

Longitude, 9h. 14m. 20·3s. E. || **Latitude**, 34° 56′ 38·5″ S.

1882.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Time by Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
					h m s	h m s	h m s	m s	
1	January 2	R	II. Tr. I.	External contact	8 53 37·07	23 39 16·77	—	—	300
2				About bisected	8 55 28·07	23 41 7·77	—	—	"
3				Internal contact	8 57 10·57	23 42 50·27	—	—	"
4	January 4	R	III. Ec. R.	First seen	7 56 16·2	22 41 55·9	22 49 47	+ 7 51	200
5				Full blaze	8 6 41·2	22 52 19·9	—	—	"
6	"	R	I. Sh. E.	Internal contact	7 58 57·2	22 44 36·9	—	—	"
7				About bisected	8 0 53·2	22 46 32·9	—	—	"
8				Limb complete	8 3 42·7	22 49 22·4	—	—	"

9	"	R	II. Ec. R.	First seen	8 20 18·2	23 5 57·9	23 6 38	+ 0 40	300
10				Quite distinct	8 20 36·2	23 6 15·9	—	—	"
11				Full blaze	8 23 57·2	23 9 36·9	—	—	"
12	January 10	R	I. Oc. D.	External contact	9 17 20·0	0 2 59·7	—	—	200
13				About bisected	9 19 10·5	0 4 50·2	—	—	"
14				Last seen	9 22 38·0	0 8 17·7	—	—	"
15	January 11	R	I. Sh. I.	First seen	7 48 36·2	22 34 15·9	—	—	300
16				About bisected	7 50 10·2	22 35 49·9	—	—	"
17				Limb complete	7 51 47·7	22 37 27·4	—	—	"
18	"	R	I. Tr. E.	Internal contact	8 44 27·0	23 30 6·7	—	—	"
19				About bisected	8 47 25·0	23 33 4·7	—	—	"
20				External contact	8 50 2·0	23 35 41·7	—	—	"
21	February 2	T	I. Oc. D.	External contact	9 27 20·3	0 13 0·0	—	—	200
22				About bisected	9 28 55·8	0 14 35·5	—	—	"
23				Disappearance	9 31 37·8	0 17 17·5	—	—	"
24	December 27	R	II. Tr. I.	External contact	9 50 31·4	0 36 11·1	—	—	300
25				About bisected	9 53 26·9	0 39 6·6	—	—	"
26				Internal contact	9 55 13·9	0 40 53·6	—	—	"
27	"	R	II. Sh. I.	First seen	10 21 13·8	1 6 53·5	—	—	"
28				Limb complete	10 24 49·3	1 10 29·0	—	—	"

REMARKS.

Ref. No.	
1 2 3	Definition not good.
4	Definition very good, but not very certain on account of too much daylight; may be a second or two late.
6 7 8	Very good.
12 13 14	Definition very bad; observations very uncertain.

Ref. No.	
17	Good. Definition fair.
18	Late, only approximate, definition good; shadow mid planet.
19 20	Fair.
21 22 23	Definition dreadful; all doubtful.
27 28	Definition very good, and limb of planet sharp and well defined.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

Longitude, 9h. 14m. 20·3s. E. || **Latitude**, 34° 56′ 38·5″ S.

1883.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
					h m s	h m s	h m s	m s	
1	January 21.........	T	II. Tr. E.	Internal contact	8 34 47·6	23 20 27·3	—	—	200
2				About bisected	8 36 45·6	23 22 25·3	—	—	"
3				External contact	8 39 11·8	23 24 51·5	—	—	"
4	January 22.........	R	I. Oc. D.	External contact	9 16 50·9	0 2 30·6	—	—	125
5				About bisected	9 19 51·4	0 5 31·1	—	—	"
6				Internal contact	9 23 1·4	0 8 41·1	—	—	"
7				Disappeared	9 23 32·3	0 9 12·0	—	—	"
8	January 23.........	T	I. Tr. E.	Internal contact	8 52 46·8	23 38 26·5	—	—	"
9				About bisected	8 54 52·3	23 40 32·0	—	—	"
10				External contact	8 56 55·3	23 42 35·0	—	—	"
11	January 26.........	C	III. Ec. R.	First seen	9 0 28·4	23 46 8·1	23 48 40	+ 2 32	200
12				Full blaze	9 5 20·4	23 51 0·1	—	—	"
13	January 28.........	T	II. Tr. I.	External contact	8 14 49·9	23 0 29·6	—	—	"
14				About bisected	8 16 6·9	23 1 46·6	—	—	"
15				Internal contact	8 18 16·9	23 3 56·6	—	—	"
16	January 30.........	T	II. Ec. R.	First seen	7 48 27·8	22 34 7·5	22 34 20	+ 0 13	"
17				Full blaze	7 52 23·3	22 38 3·0	—	—	"
18	"	T	I. Tr. I.	External contact	8 28 46·7	23 14 26·4	—	—	"
19				About bisected	8 29 59·7	23 15 39·4	—	—	"
20				Internal contact	8 32 9·5	23 17 49·2	—	—	"

21	“	C	I. Sh. I.	First seen	9 28 13·6	0 13 53·3	—	—	
22				About bisected	9 29 18·0	0 14 57·7	—	—	
23				Internal contact	9 30 11·5	0 15 51·2	—	—	“
24	“	C	I. Tr. E.	Internal contact	10 39 36·6	1 25 16·3	—	—	“
25				About bisected	10 41 11·3	1 26 51·0	—	—	“
26				External contact	10 43 19·6	1 28 59·3	—	—	“
27	January 31.........	R	I. Ec. R.	First seen	8 51 21·1	23 37 0·8	23 37 21	+ 0 20	“
28				Full blaze	8 54 55·6	23 40 35·3	—	—	“
29	February 2.........	T	III. Oc. R.	About bisected	8 54 5·2	23 39 44·9	—	—	“
30				External contact	8 58 18·2	23 43 57·9	—	—	“
31	“	R	III. Ec. D.	Very faint	10 27 37·3	1 13 17·0	—	—	125
32				Last seen	10 28 31·3	1 14 11·0	1 11 47	– 2 24	“
33	February 6.........	R	I. Tr. I.	External contact	10 18 41·5	1 4 21·2	—	—	200
34				About bisected	10 19 34·0	1 5 13·7	—	—	“
35				Internal contact	10 21 38·5	1 7 18·2	—	—	“

REMARKS.

Ref. No.	
1, 2, 3	Not well defined.
4, 5, 6, 7	Definition very bad, but good glimpses at times; whole of satellite visible through the limb.
11, 12	Definition splendid.
13, 14, 15	Definition very good.
18, 19, 20	Very good observation; satellite faint at external contact; seen through thin cirrus cloud.

Ref. No.	
21, 22, 23	When first seen limb slightly indented; definition fair.
24, 25, 26	Definition splendid.
27, 28	Not very good; seen through cirrus cloud.
29, 30	Very badly defined.
31, 32	Very distinct at times, and the disappearance was thought to be very exact.
33, 34, 35	Definition good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1883.				h m s	h m s	h m s	m s	
36	February 7.........	C	I. Oc. D.	External contact	7 24 17·4	22 9 57·1	—	—	200
37				About bisected	7 26 8·4	22 11 48·1	—	—	"
38				Internal contact	7 28 34·9	22 14 14·6	—	—	"
39	February 20.........	T	II. Oc. D.	External contact	10 21 35·4	1 7 15·1	—	—	125
40				About bisected	10 23 17·4	1 8 57·1	—	—	"
41				Internal contact	10 26 33·9	1 12 13·6	—	—	"
42	February 23.........	R	I. Ec. R.	First seen	9 7 23·6	23 53 3·3	23 53 22	+ 0 19	200
43				Full blaze	9 10 12·3	23 55 52·0	—	—	"
44	March 1............	C	I. Tr. I.	External contact	7 25 0·3	22 10 40·0	—	—	200
45				About bisected	7 26 24·9	22 12 4·6	—	—	"
46				Internal contact	—	—	—	—	"
47	March 2............	C	I. Oc. D.	External contact	7 29 40·7	22 15 20·4	—	—	"
48				About bisected	7 30 53·7	22 16 33·4	—	—	"
49				Disappeared	7 32 54·7	22 18 34·4	—	—	"
50	March 3............	S	II. Ec. R.	First seen	7 28 6·0	22 13 45·7	22 13 43	− 0 3	"
51				Full blaze	7 32 1·0	22 17 40·7	—	—	"
52	December 18........	C	III. Tr. I.	About bisected	10 48 36·1	1 34 15·8	—	—	125
53				Internal contact	10 53 23·4	1 39 3·1	—	—	"
54	"	C	III. Sh. E.	Internal contact	11 8 48·2	1 54 27·9	—	—	"
55				About bisected	11 11 58·7	1 57 38·4	—	—	—
56				External contact	11 16 24·1	2 2 3·8	—	—	—

REMARKS.

Ref. No.	
36 37 38	Definition splendid, internal contact very exact.
39 40 41	Thought I could occasionally see satellite through edge of planet, but am not certain; fairly well defined, but would not bear a high power.
42 43	Considered good.
44 45 46	Definition very good; internal contact lost through clouds coming over the planet.
47 48 49	Definition good; disappearance very exact.
54 55 56	Definition not good; fair at times; planet too low down; external contact pretty exact.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. || LATITUDE, 34° 55′ 38·5″ S.

1884

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
					h m s	h m s	h m s	m s	
1	January 3	T	I. Sh. I.	Internal contact	10 32 34·2	1 18 13·9	—	—	120
2	"	T	I. Tr. I.	External contact	10 50 42·8	1 36 22·5	—	—	"
3				About bisected	10 52 25·8	1 38 5·5	—	—	"
4				Internal contact	10 54 24·1	1 40 3·8	—	—	"
5	January 4	C	I. Oc. R.	First seen	10 16 57·8	1 2 37·5	—	—	"
6				About bisected	10 18 8·6	1 3 48·3	—	—	"
7				External contact	10 20 4·7	1 5 44·4	—	—	"
8	January 27	T	I. Ec. R.	First seen	10 4 22·3	0 50 2·0	0 50 13	+ 0 11	200
9				Full blaze	10 8 23·3	0 54 3·0	—	—	"
10	January 29	C	II. Tr. I.	External contact	11 11 6·1	1 56 45·8	—	—	120
11				Internal contact	11 15 56·1	2 1 35·8	—	—	"
12	February 18	C	I. Tr. I.	External contact	10 8 49·9	0 54 29·6	—	—	"
13				About bisected	10 11 26·4	0 57 6·1	—	—	"
14				Internal contact	10 13 29·9	0 59 9·6	—	—	"
15	February 19	C	I. Oc. D.	External contact	7 13 10·6	21 58 50·3	—	—	"
16				Internal contact	7 18 35·1	22 4 14·8	—	—	"
17	"	C	I. Ec. R.	First seen	10 16 52·2	1 2 31·9	1 2 53	+ 0 21	"
18				Full blaze	10 19 25·2	1 5 4·9	—	—	"

19	February 23	C	II. Tr. I.	About bisected	7 11 50·0	21 57 29·7	—	—	"
20				Internal contact	7 15 31·5	22 1 11·2	—	—	"
21	"	C	II. Tr. E.	About bisected	10 4 57·2	0 50 36·9	—	—	200
22				External contact	10 7 39·2	0 53 18·9	—	—	"
23	March 1	T	II. Tr. I.	Internal contact	9 37 14·3	0 22 54·0	—	—	"
24	March 3	C	II. Ec. R.	First seen	9 23 37·2	0 9 16·9	0 9 35	+ 0 18	120
25				Full blaze	9 26 10·2	0 11 49·9	—	—	"
26	March 5	T	I. Tr. I.	External contact	9 10 8·1	23 55 47·8	—	—	200
27				About bisected	9 11 30·7	23 57 10·4	—	—	"
28				Internal contact	9 13 46·0	23 59 25·7	—	—	"
29	"	C	I. Sh. I.	First seen	9 12 24·8	23 58 4·5	—	—	120
30				Internal contact	9 15 24·6	0 1 4·3	—	—	"

REMARKS.

Ref. No.	
1	Planet badly defined.
2 3 4	Definition not very good, but observation considered good.
5 6 7	Definition good.
10 11	Internal contact pretty fair; definition not good, except occasionally.
12 13 14	Definition fair at times; observation pretty good.
15 16	Definition pretty good.
17 18	Definition very good.

Ref. No.	
19 20	Definition very bad, but a good glimpse every few minutes. Internal contact fair.
21 22	Definition fair.
23	Definition splendid.
24 25	Definition fair; observation considered good.
26 27 28	Good.
29 30	Definition bad; observation very uncertain.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1884				h m s	h m s	h m s	m s	
31	March 13	C	I. Oc. D.	About bisected	7 7 52·6	21 53 32·3	—	—	120
32				Internal contact	7 10 11·4	21 55 51·1	—	—	"
33	"	C	IV. Sh. E.	Internal contact	7 22 47·3	22 8 27·0	—	—	200
34				External contact	7 32 21·8	22 18 1·5	—	—	"
35	"	C	III. Sh. I.	External contact	7 33 51·8	22 19 31·5	—	—	"
36				Internal contact	7 41 37·8	22 27 17·5	—	—	"
37	"	T	I. Ec. R.	First seen	10 30 58·5	1 16 38·2	1 17 2	+ 0 24	120
38				Full blaze	10 33 59·4	1 19 39·1	—	—	"
39	"	T	III. Sh. E.	Internal contact	10 54 19·9	1 39 59·6	—	—	200
40				About bisected	10 57 53·9	1 43 33·6	—	—	"
41				Limb indented	11 0 39·4	1 46 19·1	—	—	"
42				Limb indented	11 1 21·3	1 47 1·0	—	—	"
43				External contact	11 3 36·0	1 49 15·7	—	—	"
44	March 20	C	III. Tr. I.	External contact	6 52 42·0	21 38 21·7	—	—	"
45				About bisected	6 57 49·7	21 43 29·4	—	—	"
46				Internal contact	7 1 52·0	21 47 31·7	—	—	"
47	"	T	I. Oc. D.	External contact	8 56 28·2	23 42 7·9	—	—	"
48				About bisected	8 58 13·2	23 43 52·9	—	—	"
49				Internal contact	9 0 9·7	23 45 49·4	—	—	"
50	"	C	III. Tr. E.	About bisected	10 25 39·5	1 11 19·2	—	—	"
51				External contact	10 30 22·2	1 16 1·9	—	—	"
52	March 21	T	IV. Oc. R.	External contact	6 17 8·5	21 2 48·2	—	—	"
53	"	T	I. Tr. I.	External contact	6 19 6·8	21 4 46·5	—	—	"
54				Internal contact	6 22 6·1	21 7 45·8	—	—	"
55	"	T	I. Sh. I	First seen	7 28 58·3	22 14 38·0	—	—	"
56				Internal contact	7 31 56·1	22 17 35·8	—	—	"

57	“	T	I. Tr. E.	Internal contact	8 34 12·2	23 19 51·9	—	—	“
58				About bisected	8 36 15·4	23 21 55·1	—	—	“
59				External contact	8 38 15·0	23 23 54·7	—	—	“
60	“	T	I. Sh. E.	Internal contact	9 39 10·0	0 24 49·7	—	—	“
61				Still indented	9 42 15·0	0 27 54·7	—	—	“
62				Limb complete	9 43 4·5	0 28 44·2	—	—	“
63	March 31	C	III. Ec. R.	First seen	9 8 11·3	23 53 51·0	23 53 34	− 0 17	“
64				Full blaze	9 13 17·3	23 58 57·0	—	—	“
65	April 4	T	II. Ec. R.	First seen	9 2 59·8	23 48 39·5	23 49 4	+ 0 24	“
66				Full blaze	9 6 29·1	23 52 8·8	—	—	“
67	April 7	C	IV. Ec. D.	First contact	7 1 20·0	21 46 59·7	—	—	“
68				Disappearance	7 13 59·2	21 59 38·9	21 55 27	− 4 12	“
69	“	C	III. Oc. R.	External contact	8 0 20·9	22 46 0·6	—	—	“
70	April 15	T	IV. Tr. E.	Internal contact	7 27 19·1	22 12 58·8	—	—	“
71				Still indented	7 31 39·1	22 17 18·8		—	“
72				External contact	7 35 19·6	22 20 59·3	—	—	“

REMARKS.

Ref. No.	
31, 32	Definition of limb very good.
33, 34, 35, 36	Observations of the shadows were very good, the limb of Jupiter being very sharp. The egress of the fourth satellite's shadow took place nearly a quarter of an hour prior to its computed time in the *Nautical Almanac*.
37, 38	Satellite well defined.
39, 40, 41, 42, 43	Planet badly defined, only occasional glimpses of good definition.
44, 45, 46	Definition splendid
47, 48, 49	Planet splendidly defined.

Ref. No.	
50, 51	Definition very good.
57, 58, 59	Very good.
60, 61, 62	Observation pretty good, but shadow indistinct.
63, 64	Definition good.
65	Very exact.
68	Very exact; definition splendid.
69	Not good; limb boiling.
70	Very good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1884.				h m s	h m s	h m s	m s	
73	April 18	T	III. Sh. E.	Internal contact	6 59 51·8	21 45 31·5	—	—	200
74				About bisected	7 1 49·4	21 47 29·1	—	—	"
75				Still indented	7 3 24·8	21 49 4·5	—	—	"
76				External contact	7 4 36·2	21 50 15·9	—	—	"
77	"	C	II. Oc. D.	External contact	8 43 7·1	23 28 46·8	—	—	120
78				Disappearance	8 50 51·6	23 36 31·3	—	—	"
79	April 20	S	I. Tr. I.	External contact	8 21 50·7	23 7 30·4	—	—	200
80				Internal contact	8 26 45·9	23 12 25·6	—	—	"
81	April 21	T	I. Ec. R.	First seen	9 6 12·0	23 51 51·7	23 51 50	–0 2	120
82				Full blaze	9 10 44·0	23 56 23·7	—	—	"
83	May 6	C	I. Tr. I.	External contact	6 43 24·2	21 29 3·9	—	—	200
84				About bisected	6 45 24·2	21 31 3·9	—	—	"
85				Internal contact	6 47 29·9	21 33 9·6	—	—	"
86	"	C	I. Sh. I.	Limb indented	7 57 20·1	22 42 59·8	—	—	
87				Internal contact	7 59 32·1	22 45 11·8	—	—	"
88	"	C	II. Ec. R.	First seen	8 41 13·0	23 26 52·7	23 26 40	–0 13	"
89				Full blaze	8 44 51·0	23 30 30·7	—	—	"

REMARKS.

Ref. No.	
73	Very good.
76	Doubtful.
77 78	External contact not very good; disappearance considered pretty exact; definition fair, very good glimpses occasionally.
79 80	Planet boiling; observation not good. The second satellite was just off the planet at 6h. 2m., A.M.T.
81 82	Sky thick; definition good.

Ref. No.	
83 84 85	Definition good.
86 87	Definition fair.
88 89	Considered good, but planet very low down,.

January 27th, 10.—What looks like the Great Red Spot is observed underneath the protuberance of the white cloud on the brown belt; or, perhaps, it looks more like a bend in the brown belt. The spot is almost as long as the base of this triangular-shaped bend or protuberance, but is very faint.—T., 200.

January 29th, 11.—Underneath the large bend in the dark belt (as noted on Sunday night), can at times be seen a faint red spot of considerable extent, evidently the Great Red Spot. The dark belt is not at all well defined, but seems to form a sort of dark fringe to the equatorial light band; and there is another dark, but much narrower, belt at the northern edge of the light band. On this band itself, especially in the neighborhood of and immediately preceding the bend in the dark belt, are several well-marked bright spots. The region near the north pole is dark.—C., 120.

February 6th, 8·30.—Jupiter is very well defined through breaks in cloud. The Great Red Spot is near the central meridian, and just visible in 5in. reflector. The part of the broad dark belt where it bends upward above the Great Red Spot appears broader and not so much curved, as well as darker, than on January 27th. The bright equatorial band appears mottled, and there is a slanting streak across it. There is also, on this band, one very white and brilliant spot just above the dark belt. The north polar regions are getting darker, and the dark belt in the north temperate zone is swelling out and getting darker in nearly the same longitude as the Red Spot. There seems to be a narrow belt in the south temperate zone.—S.

February 8th, 10·30.—The belt bordering the northern edge of the equatorial band has been getting much wider lately, and now is beginning to rival that bordering the southern edge. The large bend in the latter is now about mid-transit, and I fancy that, in glimpses of good definition, I can perceive the Great Red Spot underneath the bend. The belt, in about 35° N. latitude, is also becoming much darker and broader, and seems to be swelling out in about the longitude of the Great Red Spot.—C., 120.

February 18th, 11·10.—Jupiter beautifully defined, with a power of 200 on 5in. reflector. The broad brown belt is of nearly uniform width across the planet, but about four-fifths of the way across from the preceding limb the brown belt very suddenly becomes much fainter. The dark belt on the northern boundary of the equatorial band seems continuous and appears to be getting darker, and there is a slanting streak across the equatorial band.—S.

February 19th, 7·10.—At I. Oc. D. the satellite was seen through the limb of the planet almost until internal contact, and had the appearance of a transit ingress.—C., 120.

February 19th, 11·20.—The definition to-night is very good. The southern dark belt seems to be broader than usual, and has two mountainous projections northward at about mid-transit. The equatorial band has the appearance of being covered with cirro-cumulus and there seems to be a bright spot between the two projections; but this is doubtless the effect of contrast. The dark belt bounding the north of the equatorial band is only a thin streak, while the belt at about 35° N. latitude is nearly half as broad as the southern dark belt. At about 10° above this is a narrow dark streak bounding the north polar cap. The southern edge of the southern dark belt is straight and very sharply defined; but the northern edge, although sharply defined, is irregular in outline, making the belt vary considerably in width in different parts. About 10° south of this is a narrow streak stretching right across the planet, and all south of this is the moderately dark shading of the south polar cap, a few very narrow darker streaks being just perceptible at times.—C., 120.

February 23rd, 10·7.—The belt on the northern edge of the equatorial band is narrow and faint, and the belt in about 35° N. latitude that has lately been getting much broader and darker is now scarcely visible as a distinct belt, but merges into the north polar cap. On the northern edge of the broad dark belt, about half way between the shadow of Satellite II. and the eastern limb, is an intensely bright spot about the size of the shadow; and between the spot and the shadow the belt seems to be bent slightly southwards.—C., 200.

February 26th, 8·17.—Definition very good at times. The broad dark belt has a hollow in its northern edge about half way between the central meridian and the preceding limb of the planet. At the preceding end of this bend is a curious Y-shaped protuberance, appearing to reach to the belt north of the equator with power 120, but with 200 it is seen to turn off just before reaching that belt and run along parallel to it. At the base of the Y is a most brilliant white spot, well defined; and there are two other white patches near the following limb, one on each side of a projection from the broad belt. The belt just north of the equator is not continuous, but is broken to the east of the central meridian, and there is a wide gap between the two portions. The white belt immediately south of the broad dark belt appears very brilliant, probably owing to contrast, and the shading on the south polar cap is more conspicuous than usual of late.—S., 120 and 200.

March 11th, 8.—Definition very good. The hollow in the southern dark belt is approaching the preceding limb, and its *following* edge is very sharply defined. The detail on the following limb of the planet appears blotted out, much more than on the preceding limb. On the north edge of the broad belt are two very conspicuous large white spots, close together, and of about the same size. The belt just north of the equator appears to be getting narrower, and is now continuous, with darker patches every here and there. The belt in about latitude 35° N. is much fainter than formerly, and the bulging out appearance previously noticed was not perceptible to-night. There is a short dark streak bounding the north polar cap, and there is a very faint shading on the south pole.—S.

On March 1st, when the definition was unusually clear, several well-marked streaks were noticed near the south pole, some of which extended from limb to limb, but others were seen only near the centre of the disc.—C.

March 13th, 7·8.—Definition of limb very good. I could distinctly see the satellite through the limb of the planet almost up to internal contact. The phenomenon looked almost exactly like a transit ingress, the satellite being perfectly visible as a bright spot just inside the limb of Jupiter.—C., 120.

The Great Red Spot was seen early in the evening, even when close to the limb; although distinct, it was very faint and ill-defined. The northern edge of the broad belt above the great hollow appeared to be slightly curved. —S.

March 13th, 11·15.—Planet beautifully defined. Immediately to the west of mid-transit a streak of white cloud stretches obliquely across the southern red belt.

March 20th, 8·58.—I. Oc. D. At times the satellite could be seen through the limb of the planet for about two-thirds of its diameter, but was lost at internal contact. Planet splendidly defined.—T., 200.

March 20th, 8·30.—On the southern margin of the dark-red belt is a black spot immediately to the west of the great hollow over the Great Red Spot, which can be just faintly glimpsed. The black spot is round, and about the size of the shadow of the first satellite, and appears a dusky black. Immediately over this spot a streak of white cloud runs east and west, and extends some distance to the west of the black spot, nearly bisecting the red belt. The equatorial bright belt is broken up into cumulus looking clouds, with dark or reddish spaces between. Planet splendidly defined.—T., 200. (Afterwards.)—The black spot was in mid-transit at about 8·40 p.m., and was almost exactly in the position occupied by the third satellite. A dark spot was also noticed in the same position on the night of the 18th, by Mr. Cooke, but was then not nearly so well marked as at present; the definition on that occasion was splendid.

March 20th, 10·30.—The advancing side of the great hollow in the dark belt is just going out of sight on the preceding limb of the planet. This belt appears to be splitting up, as there are several patches of white noticeable on it; one especially, extending from the eastern limb almost to the centre of the disc, running parallel to the equator, and almost bisecting the dark belt.—C., 200.

March 21st, 6·20.—There is a streak of white cloud stretching obliquely across the red belt from a little west of mid-transit to within a few degrees of the east limb. The first satellite entered on the disc on the southern edge of the equatorial band, which is broken up into cumulus-shaped clouds, with a narrow red belt to the north of the equator; and the northern regions of the planet are divided into a number of parallel streaks or narrow belts. The red spot is near the western limb, and is easily visible. (Later)—Satellite I. is plainly visible at a little past mid-transit.—T., 200.

March 21st.—Definition splendid all through the evening. In the early evening the Great Red Spot was seen near the western limb of the planet, and there was a long, slanting, white streak across the broad dark belt, starting on the northern edge from the same longitude as the following end of the hollow in the broad belt, and extending about 70° of longitude east of the hollow. There were numerous projections along the northern edge of the broad belt. Just south of the north polar cap was a dusty streak, which at 6·38 was bent southwards a little past mid-transit. nearly reaching the flat belt in about latitude 35° N. Later in the evening (8·10) the equatorial light band was seen festooned with faint arches, which rose from the numerous projections on the north edge of the broad dark belt. The white slanting streak on the dark belt was very well defined, reaching very close indeed to the southern edge of the belt. In about latitude 35° S., and in mid-transit, at about 8·10, was a curious dusky spot, nearly round, and with a clear space all round it, two narrow belts on opposite sides of it coming to an end just before reaching the spot, and the south polar shading being slightly hollowed out below it, and of a slightly darker shade immediately south of this spot. The dark belt just north of the equator was slightly bent southwards just past mid-transit, and was broken near the eastern limb, the end of the eastern portion being straight and well defined.—S., 200.

March 26th, 7·55.—Definition good. There is a wide break between two portions of the narrow dark belt just north of the equator, and on the western edge of the eastern portion is a small round black spot. It requires moments of good definition to distinguish it, but it is certainly there. It is about half way between mid-transit and the western limb.—S., 200.

April 7th, 7.—One of the white cloud streaks that have lately been noticed on the broad dark belt is just going off the planet. It is lying across the belt at about an angle of 30° to the equator. The white equatorial belt seems to be undergoing considerable change. On the northern edge of the broad dark belt are a series of protuberances, whose tops are united by what appears, in moments of somewhat unsteady definition, to be a narrow dark streak almost on the equator; but when the definition is at its best it is seen that the protuberances and the dark streak combined constitute a beautiful series of festoons, the interiors of which, doubtless owing in a great measure to the effect of contrast, seem to be dazzlingly white. Above the narrow streak forming the roof of the festoons, between it and the dark belt, in about latitude 7° N., the equatorial band has lost its intensely white color, and the cumulus-looking clouds it had a short time previously, and is now as dark as the north polar shading, and there seem to be several small streaks parallel to the equator in moments of very good definition. In about latitude 35° N. is a well-defined dark belt, about 4° in width, stretching right across the planet, and immediately south of this is a very narrow dark belt parallel to the former. Another well-marked belt is noticeable in about latitude 45° N., and the north polar shading seems to commence at about latitude 50°. To the south of the broad dark belt, just past mid-transit, is the dusky spot noticed on March 21st. It does not seem to have changed in the least. There is still the narrow dark streak breaking off abruptly to the east and west of it, and it still seems to be set in a white patch about the size of the famous red spot; while directly to the south the polar shading is considerably darker than usual. There is not much detail, with the exception of this spot, noticeable to the south of the broad dark belt; the polar shading seems to commence with the dark streak which breaks off on each side of the dusky spot. Definition splendid.—C., 200.

April 15th, 7·30.—IV. Tr. E. The satellite is as dark as any shadow, perfectly black. At 7h. 31m. 39·1s. ("limb still indented"), the portion of the satellite outside the limb was totally invisible; first caught sight of it at 7h. 32 m. 34s. After external contact the satellite was very small and faint.—T., 200.

April 21st, 5·51.—The centre of the great hollow in the broad dark belt is just at mid-transit. The definition is splendid, and the Great Red Spot, or all that remains of it, is plainly visible. It is now of a different shape to that shown by Mr. Denning in the March number of the *Observatory*, being narrow and having both its northern and southern edges concave to the south. Its eastern extremity joins a narrow diffused belt running eastward. To the south of the bright region which surrounds the red spot is a belt, which swells out in the same longitude as the spot, the swelling being of a shade slightly deeper than the spot. The narrow white streaks on each side of the hollow in the broad dark belt are plainly visible. The portion of the belt south of the streak on the western side of the hollow is very red, and appears very striking. The color (a crimson-brown) is darkest and deepest at the south-west extremity of the curve formed by the great hollow. The oval white spot seen by Mr. Denning on February 6th on the broad dark belt and south (*sic*) of the preceding end of the red spot, has either disappeared altogether or has changed its position considerably, no sign of it being visible, although the definition is unusually good. The festoons on the equatorial bright band are very well seen, but are not so dark or distinct on this side of the planet. The belt about 7° N. of the equator is not continuous, but is broken up into patches, one of which has a dusky black spot on its western edge—at times it appeared a little round black dot; it was previously noticed on March 26th. The markings in high northern latitudes are very indistinct, but the principal belt (about 35° N.) becomes darker and more distinct near the eastern limb.—S., 200.

May 5th, 5·31.—Definition splendid; only about 15 minutes after sunset. The preceding end of the great hollow in the broad dark belt is just within the planet's limb. The part of the belt north of the white streak which precedes the hollow is breaking up and gathering itself into knots, two of which are very dark and conspicuous. Only two festoons are noticeable, but they are very plain indeed, striking the eye immediately on looking at the planet. The black spot on the belt north of the equator noticed before on March 26th and April 21st, has gained considerably on the Great Red Spot, being now far in advance of it. It still preserves much the same appearance as formerly, but the short belt on which it was situated appears now to be connected with the belt immediately following. The fine narrow streaks on each side of the dark belt, in about latitude 35° N., are both well seen, the southern being the plainer. There is a rather broad pale belt dividing the north polar cap, in about latitude 60° N. The south pole has a very faint grey shading, but no detail can be made out. Later in the evening, when the red spot was on the disc, the definition was not very good, but in one good glimpse the spot was plainly seen, of the same shape as on April 21st. The broad dark belt north of the hollow is getting broader and more uneven on its northern edge, and the belt just north of the equator is getting much broader and darker to the east of the longitude of the hollow.—S.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES, ETC.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

Longitude, 9h. 14m. 20·3s. E. || **Latitude, 34° 55′ 38·5″ S.**

1885.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
					h m s	h m s	h m s	m s	
1	January 7.........	C	I. Tr. E.	Internal contact	11 5 6·7	1 50 46·4	—	—	200
2				About bisected	11 7 13·7	1 52 53·4	—	—	“
3				External contact	11 10 12·5	1 55 52·2	—	—	“
4	January 15.........	C	I. Oc. R.	First seen	10 6 54·1	0 52 33·8	—	—	125
5				External contact	10 10 46·3	0 56 26·0	—	—	“
6	February 16.........	C	II. Sh. E.	Internal contact	10 28 17·0	1 13 56·7	—	—	200
7				About bisected	10 29 22·2	1 15 1·9	—	—	“
8				Limb complete	10 30 47·7	1 16 27·4	—	—	“
9	“	C	II. Tr. E.	Internal contact	10 33 45·9	1 19 25·6	—	—	“
10				About bisected	10 35 18·4	1 20 58·1	—	—	“
11				External contact	10 37 35·7	1 23 15·4	—	—	“
12	February 21.........	C	I. Oc. D.	External contact	10 53 42·8	1 39 22·5	—	—	“
13				About bisected	10 55 49·8	1 41 29·5	—	—	“
14				Last seen	10 57 28·0	1 43 7·7	—	—	“
15	“	C	I. Ec. R.	First seen	13 15 27·6	4 1 7·3	4 0 59	−0 8	150
16				Full blaze	13 17 27·6	4 3 7·3	—	—	“
17	February 22.........	C	I. Tr. I.	External contact	8 9 49·7	22 55 29·4	—	—	“
18				About bisected	8 11 23·6	22 57 3·3	—	—	“
19				Internal contact	8 14 36·8	23 0 16·5	—	—	“
20	“	C	I. Sh. I.	Limb indented	8 17 38·8	23 3 18·5	—	—	“
21				Limb complete	8 20 35·5	23 6 15·2	—	—	“
22	“	C	I. Tr. E.	Internal contact	10 27 26·4	1 13 6·1	—	—	250
23				About bisected	10 29 54·3	1 15 34·0	—	—	“
24				External contact	10 38 6·9	1 18 46·6	—	—	“
25	“	C	I. Sh. E.	Internal contact	10 33 31·6	1 19 11·3	—	—	“
26				Limb complete	10 35 47·7	1 21 27·4	—	—	“

27 28 29	February 23.........	C	II. Tr. I.	External contact About bisected Internal contact	9 55 30·9 9 57 57·9 10 2 30·9	0 41 10·6 0 43 37·6 0 48 10·6	— — —	— — —	150 " "
30 31 32	"	C	II. Tr. E.	Internal contact About bisected External contact	12 47 59·6 12 50 54·6 12 54 2·6	3 33 39·3 3 36 34·3 3 39 42·3	— — —	— — —	" " "
33 34 35	"	C	II. Sh. E.	Internal contact Still indented External contact	13 2 20·6 13 4 17·6 13 4 57·6	3 48 0·3 3 49 57·3 3 50 37·3	— — —	— — —	" " "
36 37 38	February 25.........	C	II. Ec. R.	First seen Quite distinct Full blaze	8 5 29·3 8 5 56·4 8 8 44·8	22 51 9·0 22 51 36·1 22 54 24·5	22 51 26 — —	+ 0 17 — —	" " "
39 40 41	February 28.........	C	I. Oc. D.	External contact About bisected Last seen	12 36 6·7 12 38 6·7 12 40 35·7	3 21 46·4 3 23 46·4 3 26 15·4	— — —	— — —	" " "

REMARKS.

Ref. No.	
1 2 3	Planet very low down; definition not very good; limb woolly.
4 5	Definition variable, good at times. (Jupiter directly over a large bush fire.)
6 7 8	Definition very good.
9 10 11	Definition good.
12 13 14	Definition good; last observation very good. Note.—I distinctly saw the satellite *through* the planet's limb, up to near bisection. The limb was sharply defined, and the whole of the satellite was visible for some time after that noted as external contact. The time noted for internal contact was when the last minute speck of light faded away, but this speck appeared to be *inside* the limb of Jupiter. The actual internal contact of the satellite's and planet's limbs appeared to me to take place some 10 or 15 seconds earlier.
15 16	May be a few seconds late, as it reappeared very close to the planet's limb; definition very good.
17 18 19	Definition fair; Jupiter very low down.
20 21	Definition fair; Jupiter very low down. The external contact of shadow is not to be depended upon, as when the shadow appeared on the planet it seemed to be almost overlapped by the satellite. The internal contact or limb complete is, however, pretty good.
22 23 24	Definition good.
25 26	Definition good.
27 28 29	Definition fair, with scattered clouds at first, but towards the end of the observation the definition was very good.
30 31 32	Definition splendid.
33 34 35	Definition very good. The shadow appeared very small compared with the satellite.
36 37 38	Very good observation.
39 40 41	Definition good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
42	February 28.........	C	I. Ec. R.	First seen	15 9 18·5	5 54 58·2	5 54 57	− 0 1	150
43				Quite distinct	15 9 32·3	5 55 12·0	—	—	"
44				Full blaze	15 13 22·3	5 59 2·0	—	—	"
45	March 1...........	C	I. Tr. I.	External contact	9 51 42·1	0 37 21·8	—	—	"
46				Internal contact	9 56 54·7	0 42 34·4	—	—	"
47	March 2...........	C	I. Ec. R.	First seen	9 38 5·2	0 23 44·9	0 23 27	− 0 18	"
48				Quite distinct	9 38 18·1	0 23 57·8	—	—	"
49				Full blaze	9 42 18·1	0 27 57·8	—	—	"
50	"	C	II. Tr. I.	External contact	12 9 37·7	2 55 17·4	—	—	"
51				About bisected	12 12 7·7	2 57 47·4	—	—	"
52				Internal contact	12 15 43·7	3 1 23·4	—	—	"
53	"	C	II. Sh. I.	*Vide* remarks.					
54	March 4...........	C	II. Ec. R.	First seen	10 41 45·2	1 27 24·9	1 27 51	+ 0 26	200
55				Quite distinct	10 41 52·5	1 27 32·2	—	—	"
56				Full blaze	10 45 47·5	1 31 27·2	—	—	"
57	March 8...........	C	I. Tr. I.	External contact	11 40 0·0	2 25 39·7	—	—	"
58				About bisected	11 42 6·0	2 27 45·7	—	—	"
59				Internal contact	11 43 56·0	2 29 35·7	—	—	"
60	"	C	IV. Ec. R.	First seen	11 53 45·0	2 39 24·7	2 39 47	+ 0 22	"
61				Quite distinct	11 54 0·0	2 39 39·7	—	—	"
62				Full blaze	11 51 40 0	2 44 19·7	—	—	"
63	"	C	I. Sh. I.	First seen	12 6 21·0	2 52 0·7	—	—	"
64				Internal contact	12 8 16·0	2 53 55·7	—	—	"
65	"	C	I. Tr. E.	External contact	14 0 33·8	4 46 13·5	—	—	"
66	"	C	I. Sh. E.	Internal contact	14 21 6·7	5 6 46·4	—	—	"
67				Still indented	14 24 12·7	5 9 52·4	—	—	"
68				Limb complete	14 24 25·7	5 10 5·4	—	—	"
69	March 9...........	S	I. Oc. D.	External contact	8 47 32·1	23 33 11·8	—	—	"
70				About bisected	8 49 47·1	23 35 26·8	—	—	"
71				Limb complete	8 51 7·1	23 36 46·8	—	—	"
72	"	S	I. Ec. R.	First seen	11 31 47·7	2 17 27·4	2 17 36	+ 0 9	"
73				Full blaze	11 35 56·7	2 21 36·4	—	—	"

74	“	S	II. Tr. I.	External contact	14 23 56·3	5 9 36·0	—	—	“
75				About bisected	14 26 26·3	5 12 6·0	—	—	“
76				Internal contact	14 29 36·3	5 15 16·0	—	—	“
77	March 10...........	S	III. Ec. R.	First seen	8 0 49·1	22 46 28·8	22 46 52	+ 0 23	“
78				Quite distinct	8 1 34·1	22 47 13·8	—	—	“
79				Full blaze	8 6 34·1	22 52 13·8	—	—	“
80	“	S	I. Tr. E.	Internal contact	8 21 29·1	23 7 8·8	—	—	“
81				External contact	8 26 9·1	23 11 48·8	—	—	“
82	“	S	I. Sh. E.	Internal contact	8 50 19·0	23 35 58·7	—	—	“
83				Limb complete	8 52 54·0	23 38 33·7	—	—	“
84	March 15...........	S	I. Tr. I.	External contact	13 22 39·3	4 8 19·0	—	—	“
85				About bisected	13 25 35·3	4 11 15·0	—	—	“
86				Internal contact	13 28 50·3	4 14 30·0	—	—	“
87	“	S	I. Sh. I.	Internal contact	14 3 0·3	4 48 40·0	—	—	“

REMARKS.

Ref. No.	
42 43 44	Definition pretty good; observation considered good.
45 46	Definition bad.
47 48 49	Definition fair; scattered cirrus about.
50 51 52	Definition good, but planet rather faint owing to presence of thin cirro-stratus.
53	No sign of shadow up to 12·53, although limb was sharply defined.
54 55 56	Very exact; definition splendid.
57 58 59	Definition splendid. Satellite beautifully defined.
60 61 62	Very good observation.
63 64	Definition splendid. Internal contact considered very good.
65	Definition good.
66 67 68	Definition good.
69 70 71	Definition good.
72	Might be five seconds late.
74 75 76	Planet getting low; definition not good.
77 78 79	Definition splendid.
80 81	Definition very bad at internal contact, but external contact very good.
82	Good.
84 85 86	Good.
87	Not good; planet boiling. Shadow not seen till near internal contact.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
88	March 16	S	IV. Tr. I.	External contact	9 2 57·0	23 48 36·7	—	—	200
89				About bisected	9 9 52·0	23 55 31·7	—	—	"
90				Internal contact	9 16 47·0	0 2 26·7	—	—	"
91	"	S	I. Oc. D.	External contact	10 30 46·7	1 16 26·4	—	—	125
92				Limb complete	10 35 36·7	1 21 16·4	—	—	"
93	"	S	I. Ec. R.	First seen	13 25 59·3	4 11 39·0	4 11 54	+ 0 15	"
94				Full blaze	13 30 26·3	4 16 6·0	—	—	"
95	"	S	IV. Tr. E.	External contact	13 53 41·3	4 39 21·0	—	—	"
96	March 17	S	I. Tr. I.	Internal contact	7 57 4·8	22 42 44·5	—	—	200
97	"	S	I. Sh. I.	First seen	8 29 14·8	23 14 54·5	—	—	"
98				Internal contact	8 31 39·8	23 17 19·5	—	—	"
99	"	S	I. Sh. E.	Internal contact	10 44 24·5	1 30 4·2	—	—	"
100				Still indented	10 47 9·5	1 32 49·2	—	—	"
101				Limb complete	10 47 34·5	1 33 14·2	—	—	"
102	"	S	III. Ec. R.	First seen	11 59 55·4	2 45 35·1	2 45 12	− 0 23	125
103				Full blaze	12 5 44·4	2 51 24·1	—	—	"
104	March 18	C	I. Ec. R.	First seen	7 54 45·1	22 40 24·8	22 40 30	+ 0 5	200
105				Quite distinct	7 54 56·9	22 40 36·6	—	—	"
106				Full blaze	7 58 51·9	22 44 31·6	—	—	"
107	"	S	II. Oc. D.	External contact	11 39 41·3	2 25 21·0	—	—	"
108				About bisected	11 43 49·3	2 29 29·0	—	—	"
109				Still visible	11 45 11·3	2 30 51·0	—	—	"
110				Disappearance	11 45 29·3	2 31 9·0	—	—	"
111	March 20	S	II. Tr. E.	External contact	8 48 36·9	23 34 16·6	—	—	"
112	March 23	S	I. Oc. D.	External contact	12 17 7·1	3 2 46·8	—	—	"
113				About bisected	12 19 59·1	3 5 38·8	—	—	"
114				Still visible	12 21 32·1	3 7 11·8	—	—	"
115				Disappearance	12 21 42·1	3 7 21·8	—	—	"
116	March 24	S	I. Tr. I.	About bisected	9 38 54·8	0 24 34·5	—	—	"
117				Internal contact	9 42 4·8	0 27 44·5	—	—	"
118	"	S	I. Sh. I.	First seen	10 24 14·7	1 9 54·4	—	—	125
119				Internal contact	10 26 54·7	1 12 34·4	—	—	"

120	March 27	S	II. Tr. I.	External contact	8 10 15·9	22 55 55·6	—	—	200
121				About bisected	8 12 15·9	22 57 55·6	—	—	"
122				Internal contact	8 14 30·9	23 0 10·6	—	—	"
123	"	S	II. Sh. I.	First seen	9 48 40·7	0 34 20·4	—	—	"
124				Internal contact	9 51 5·7	0 36 45·4	—	—	"
125	"	S	II. Tr. E.	Internal contact	11 1 15·5	1 46 55·2	—	—	"
126				About bisected	11 3 10·5	1 48 50·2	—	—	"
127				External contact	11 5 40·5	1 51 20·2	—	—	"
128	April 1	S	I. Oc. D.	External contact	8 31 35·8	23 17 15·5	—	—	"
129				Still visible	8 35 25·8	23 21 5·5	—	—	"
130				Disappearance	8 35 33·8	23 21 13·5	—	—	"
131	"	S	I. Ec. R.	First seen	11 43 39·5	2 29 19·2	2 29 35	+ 0 16	"
132				Quite distinct	11 43 45·5	2 29 25·2	—	—	"
133				Full blaze	11 46 20·5	2 32 0·2	—	—	"
134	April 2	S	I. Tr. E.	Internal contact	8 9 18·2	22 54 57·9	—	—	"
135				External contact	8 12 43·2	22 58 22·9	—	—	"
136	"	S	IV. Sh. I.	Internal contact	8 49 33·2	23 35 12·9	—	—	"

REMARKS.

Ref. No.

88, 89, 90 Observation good. Note.—At its ingress the portion of IV. within the limb was quite invisible, although the definition was fairly good, but at 10h. 33m. A.M.T. it was visible about half way between mid-transit and the eastern limb as an intensely black disc.

91, 92 External contact very good, but "limb complete" uncertain. Definition not good.

93, 94 Good observations.

95 Definition pretty fair at times; observations considered good. Note.—The satellite throughout its transit was a deep black, becoming very small as it approached the limb. When just within the limb it was glimpsed as a tiny black dot and then lost sight of and not seen again till nearly half off the planet, but the limb was boiling slightly. When right off the disc the satellite was extremely faint.

96 Good observation.

102, 103 Definition very bad; good glimpses now and again.

104, 105, 106 No. 104 very exact; afterward planet's limb was boiling; few scattered cumulus clouds about.

Ref. No.

107, 108, 109, 110 External contact not very good. Limb boiling and satellite unsteady. Bisection was good, the planet's limb cutting it off sharply, the difference in color and brightness being very noticeable.

111 Definition bad.

116, 117 Definition good; bisection probably too early.

120, 121, 122 Definition very good.

123, 124 Definition good.

128, 129, 130 Definition good.

131, 132, 133 Good observation.

134 Perhaps a little late.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
88	March 16...........	S	IV. Tr. I.	External contact	9 2 57·0	23 48 36·7	—	—	200
89				About bisected	9 9 52·0	23 55 31·7	—	—	"
90				Internal contact	9 16 47·0	0 2 26·7	—	—	"
91	"	S	I. Oc. D.	External contact	10 30 46·7	1 16 26·4	—	—	125
92				Limb complete	10 35 36·7	1 21 16·4	—	—	"
93	"	S	I. Ec. R.	First seen	13 25 59·3	4 11 39·0	4 11 54	+ 0 15	"
94				Full blaze	13 30 26·3	4 16 6·0	—	—	"
95	"	S	IV. Tr. E.	External contact	13 53 41·3	4 39 21·0	—	—	"
96	March 17...........	S	I. Tr. I.	Internal contact	7 57 4·8	22 42 44·5	—	—	200
97	"	S	I. Sh. I.	First seen	8 29 14·8	23 14 54·5	—	—	"
98				Internal contact	8 31 39·8	23 17 19·5	—	—	"
99	"	S	I. Sh. E.	Internal contact	10 44 24·5	1 30 4·2	—	—	"
100				Still indented	10 47 9·5	1 32 49·2	—	—	"
101				Limb complete	10 47 34·5	1 33 14·2	—	—	"
102	"	S	III. Ec. R.	First seen	11 59 55·4	2 45 35·1	2 45 12	− 0 23	125
103				Full blaze	12 5 44·4	2 51 24·1	—	—	"
104	March 18...........	C	I. Ec. R.	First seen	7 54 45·1	22 40 24·8	22 40 30	+ 0 5	200
105				Quite distinct	7 54 56·9	22 40 36·6	—	—	"
106				Full blaze	7 58 51·9	22 44 31·6	—	—	"
107	"	S	II. Oc. D.	External contact	11 39 41·3	2 25 21·0	—	—	"
108				About bisected	11 43 49·3	2 29 29·0	—	—	"
109				Still visible	11 45 11·3	2 30 51·0	—	—	"
110				Disappearance	11 45 29·3	2 31 9·0	—	—	"
111	March 20...........	S	II. Tr. E.	External contact	8 48 36·9	23 34 16·6	—	—	"
112	March 23...........	S	I. Oc. D.	External contact	12 17 7·1	3 2 46·8	—	—	"
113				About bisected	12 19 59·1	3 5 38·8	—	—	"
114				Still visible	12 21 32·1	3 7 11·8	—	—	"
115				Disappearance	12 21 42·1	3 7 21·8	—	—	"
116	March 24	S	I. Tr. I.	About bisected	9 38 54·8	0 24 34·5	—	—	"
117				Internal contact	9 42 4·8	0 27 44·5	—	—	"
118	"	S	I. Sh. I.	First seen	10 24 14·7	1 9 54·4	—	—	125
119				Internal contact	10 26 54·7	1 12 34·4	—	—	"

120	March 27	S	II. Tr. I.	External contact	8 10 15·9	22 55 55·6	—	—	200
121				About bisected	8 12 15·9	22 57 55·6	—	—	"
122				Internal contact	8 14 30·9	23 0 10·6	—	—	"
123	"	S	II. Sh. I.	First seen	9 48 40·7	0 34 20·4	—	—	"
124				Internal contact	9 51 5·7	0 36 45·4	—	—	"
125	"	S	II. Tr. E.	Internal contact	11 1 15·5	1 46 55·2	—	—	"
126				About bisected	11 3 10·5	1 48 50·2	—	—	"
127				External contact	11 5 40·5	1 51 20·2	—	—	"
128	April 1	S	I. Oc. D.	External contact	8 31 35·8	23 17 15·5	—	—	"
129				Still visible	8 35 25·8	23 21 5·5	—	—	"
130				Disappearance	8 35 33·8	23 21 13·5	—	—	"
131	"	S	I. Ec. R.	First seen	11 43 39·5	2 29 19·2	2 29 35	+ 0 16	"
132				Quite distinct	11 43 45·5	2 29 25·2	—	—	"
133				Full blaze	11 46 20·5	2 32 0·2	—	—	"
134	April 2	S	I. Tr. E.	Internal contact	8 9 18·2	22 54 57·9	—	—	"
135				External contact	8 12 43·2	22 58 22·9	—	—	"
136	"	S	IV. Sh. I.	Internal contact	8 49 33·2	23 35 12·9	—	—	"

REMARKS.

Ref. No.	
88 89 90	Observation good. Note.—At its ingress the portion of IV. within the limb was quite invisible, although the definition was fairly good, but at 10h. 33m. A.M.T. it was visible about half way between mid-transit and the eastern limb as an intensely black disc.
91 92	External contact very good, but "limb complete" uncertain. Definition not good.
93 94	Good observations.
95	Definition pretty fair at times; observations considered good. Note.—The satellite throughout its transit was a deep black, becoming very small as it approached the limb. When just within the limb it was glimpsed as a tiny black dot and then lost sight of and not seen again till nearly half off the planet, but the limb was boiling slightly. When right off the disc the satellite was extremely faint.
96	Good observation.
102 103	Definition very bad; good glimpses now and again.
104 105 106	No. 104 very exact; afterward planet's limb was boiling; few scattered cumulus clouds about.

Ref. No.	
107 108 109 110	External contact not very good. Limb boiling and satellite unsteady. Bisection was good, the planet's limb cutting it off sharply, the difference in color and brightness being very noticeable.
111	Definition bad.
116 117	Definition good; bisection probably too early.
120 121 122	Definition very good.
123 124	Definition good.
128 129 130	Definition good.
131 132 133	Good observation.
134	Perhaps a little late.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
88	March 16...........	S	IV. Tr. I.	External contact	9 2 57·0	23 48 36·7	—	—	200
89				About bisected	9 9 52·0	23 55 31·7	—	—	"
90				Internal contact	9 16 47·0	0 2 26·7	—	—	"
91	"	S	I. Oc. D.	External contact	10 30 46·7	1 16 26·4	—	—	125
92				Limb complete	10 35 36·7	1 21 16·4	—	—	"
93	"	S	I. Ec. R.	First seen	13 25 59·3	4 11 39·0	4 11 54	+ 0 15	"
94				Full blaze	13 30 26·3	4 16 6·0	—	—	"
95	"	S	IV. Tr. E.	External contact	13 53 41·3	4 39 21·0	—	—	"
96	March 17...........	S	I. Tr. I.	Internal contact	7 57 4·8	22 42 44·5	—	—	200
97	"	S	I. Sh. I.	First seen	8 29 14·8	23 14 54·5	—	—	"
98				Internal contact	8 31 39·8	23 17 19·5	—	—	"
99	"	S	I. Sh. E.	Internal contact	10 44 24·5	1 30 4·2	—	—	"
100				Still indented	10 47 9·5	1 32 49·2	—	—	"
101				Limb complete	10 47 34·5	1 33 14·2	—	—	"
102	"	S	III. Ec. R.	First seen	11 59 55·4	2 45 35·1	2 45 12	– 0 23	125
103				Full blaze	12 5 44·4	2 51 24·1	—	—	"
104	March 18...........	C	I. Ec. R.	First seen	7 54 45·1	22 40 24·8	22 40 30	+ 0 5	200
105				Quite distinct	7 54 56·9	22 40 36·6	—	—	"
106				Full blaze	7 58 51·9	22 44 31·6	—	—	"
107	"	S	II. Oc. D.	External contact	11 39 41·3	2 25 21·0	—	—	"
108				About bisected	11 43 49·3	2 29 29·0	—	—	"
109				Still visible	11 45 11·3	2 30 51·0	—	—	"
110				Disappearance	11 45 29·3	2 31 9·0	—	—	"
111	March 20...........	S	II. Tr. E.	External contact	8 48 36·9	23 34 16·6	—	—	"
112	March 23...........	S	I. Oc. D.	External contact	12 17 7·1	3 2 46·8	—	—	"
113				About bisected	12 19 59·1	3 5 38·8	—	—	"
114				Still visible	12 21 32·1	3 7 11·8	—	—	"
115				Disappearance	12 21 42·1	3 7 21·8	—	—	"
116	March 24	S	I. Tr. I.	About bisected	9 38 54·8	0 24 34·5	—	—	"
117				Internal contact	9 42 4·8	0 27 44·5	—	—	"
118	"	S	I. Sh. I.	First seen	10 24 14·7	1 9 54·4	—	—	125
119				Internal contact	10 26 54·7	1 12 34·4	—	—	"

120	March 27	S	II. Tr. I.	External contact	8 10 15·9	22 55 55·6	—	—	200
121				About bisected	8 12 15·9	22 57 55·6	—	—	"
122				Internal contact	8 14 30·9	23 0 10·6	—	—	"
123	"	S	II. Sh. I.	First seen	9 48 40·7	0 34 20·4	—	—	"
124				Internal contact	9 51 5·7	0 36 45·4	—	—	"
125	"	S	II. Tr. E.	Internal contact	11 1 15·5	1 46 55·2	—	—	"
126				About bisected	11 3 10·5	1 48 50·2	—	—	"
127				External contact	11 5 40·5	1 51 20·2	—	—	"
128	April 1	S	I. Oc. D.	External contact	8 31 35·8	23 17 15·5	—	—	"
129				Still visible	8 35 25·8	23 21 5·5	—	—	"
130				Disappearance	8 35 33·8	23 21 13·5	—	—	"
131	"	S	I. Ec. R.	First seen	11 43 39·5	2 29 19·2	2 29 35	+ 0 16	"
132				Quite distinct	11 43 45·5	2 29 25·2	—	—	"
133				Full blaze	11 46 20·5	2 32 0·2	—	—	"
134	April 2	S	I. Tr. E.	Internal contact	8 9 18·2	22 54 57·9	—	—	"
135				External contact	8 12 43·2	22 58 22·9	—	—	"
136	"	S	IV. Sh. I.	Internal contact	8 49 33·2	23 35 12·9	—	—	"

REMARKS.

Ref. No.	
88 89 90	Observation good. Note.—At its ingress the portion of IV. within the limb was quite invisible, although the definition was fairly good, but at 10h. 33m. A.M.T. it was visible about half way between mid-transit and the eastern limb as an intensely black disc.
91 92	External contact very good, but "limb complete" uncertain. Definition not good.
93 94	Good observations.
95	Definition pretty fair at times; observations considered good. Note.—The satellite throughout its transit was a deep black, becoming very small as it approached the limb. When just within the limb it was glimpsed as a tiny black dot and then lost sight of and not seen again till nearly half off the planet, but the limb was boiling slightly. When right off the disc the satellite was extremely faint.
96	Good observation.
102 103	Definition very bad; good glimpses now and again.
104 105 106	No. 104 very exact; afterward planet's limb was boiling; few scattered cumulus clouds about.

Ref. No.	
107 108 109 110	External contact not very good. Limb boiling and satellite unsteady. Bisection was good, the planet's limb cutting it off sharply, the difference in color and brightness being very noticeable.
111	Definition bad.
116 117	Definition good; bisection probably too early.
120 121 122	Definition very good.
123 124	Definition good.
128 129 130	Definition good.
131 132 133	Good observation.
134	Perhaps a little late.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
137	April 8	C	I. Oc. D.	External contact	10 19 38·0	1 5 17·7	—	—	200
138				About bisected	10 21 26·0	1 7 5·7	—	—	"
139				Still visible	10 23 32·0	1 9 11·7	—	—	"
140				Disappearance	10 23 42·0	1 9 21·7	—	—	"
141	April 9	C	I. Tr. I.	External contact	7 40 39·6	22 26 19·3	—	—	300
142				About bisected	7 42 58·6	22 28 38·3	—	—	"
143				Internal contact	7 45 13·6	22 30 53·3	—	—	"
144	"	C	I. Sh. I.	First seen	8 42 38·0	23 28 17·7	—	—	200
145				Internal contact	8 45 29·5	23 31 9·2	—	—	"
146	"	C	I. Tr. E.	Internal contact	9 57 33·3	0 43 13·0	—	—	300
147				About bisected	9 59 23·3	0 45 3·0	—	—	"
148				External contact	10 1 37·3	0 47 17·0	—	—	"
149	"	C	I. Sh. E.	Internal contact	10 57 33·2	1 43 12·9	—	—	200
150				Limb complete	11 0 25·2	1 46 4·9	—	—	"
151	April 10	C	I. Ec. R.	First seen	8 7 12·7	22 52 52·4	22 52 57	+ 0 5	"
152				Quite distinct	8 7 20·9	22 53 0·6	—	—	"
153				Full blaze	8 10 50·9	22 56 30·6	—	—	"
154	"	C	IV. Oc. D.	External contact	9 23 30·8	0 9 10·5	—	—	"
155				Still visible	9 31 10·8	0 16 50·5	—	—	"
156				Disappearance	9 31 26·8	0 17 6·5	—	—	"
157	April 17	C	I. Oc. D.	External contact	6 37 24·0	21 23 3·7	—	—	300
158				About bisected	6 39 11·0	21 24 50·7	—	—	"
159				Internal contact	6 40 50·0	21 26 29·7	—	—	"
160	April 27	C	IV. Oc. R.	External contact	6 36 35·7	21 22 15·4	—	—	200
161	April 28	C	II. Tr. I.	External contact	7 4 3·1	21 49 42·8	—	—	"
162				About bisected	7 6 27·1	21 52 6·8	—	—	"
163				Internal contact	7 8 40·1	21 54 19·8	—	—	"
164	"	C	II. Sh. I.	Internal contact	9 32 12·8	0 17 52·5	—	—	"
165	"	C	II. Tr. E.	About bisected	9 58 32·8	0 44 12·5	—	—	"
166				External contact	10 0 25·8	0 46 5·5	—	—	"
167	April 29	S	III. Oc. R.	First seen	7 1 35·8	21 47 15·5	—	—	"
168				External contact	7 3 0·8	21 48 40·5	—	—	"

169 170	"	S	III. Ec. D.	Very faint Disappearance	8 30 30·7 8 30 52·7	23 16 10·4 23 16 32·4	— 23 12 41	— – 3 51	" "
171 172 173	"	C	III. Ec. R.	First seen Quite distinct Full blaze	11 53 44·2 11 53 57·4 12 1 10·4	2 39 23·9 2 39 37·1 2 46 50·1	2 38 10 — —	– 1 14 — —	125 " "
174 175 176	April 30	C	II. Ec. R.	First seen Quite distinct Full blaze	7 30 51·6 7 31 5·8 7 35 7·8	22 16 31·3 22 16 45·5 22 20 47·5	22 17 17 — —	+ 0 46 — —	200 " "
177 178 179	May 2	C	I. Tr. I.	External contact About bisected Internal contact	7 41 26·1 7 44 9·1 7 46 9·1	22 27 5·8 22 19 48·8 22 31 48·8	— — —	— — —	300 " "
180 181 182	May 10	C	I. Oc. D.	External contact About bisected Last seen	6 42 1·5 6 43 44·5 6 45 22·5	21 27 41·2 21 29 24·2 21 31 2·2	— — —	— — —	200 " "

REMARKS.

Ref. No.	
137 138 139 140	Good observation.
141 142 143	Definition very good.
144 145	Definition very good.
146 147 148	Definition very good.
149 150	Definition of limb very sharp. The shadow was very small, but well defined.
151 152 153	Considered very good.
154 155 156	Considered good. Definition of limb very sharp. The satellite seen very much fainter just before external contact than half an hour previously. I felt almost sure at times, when the definition was unusually good, that I could glimpse part of the satellite behind the Jovian limb, although the satellite was so faint, but could not be quite certain about it.
157 158 159	Definition good; limb very sharp at times.

Ref. No.	
160	Definition good at times.
161 162 163	Definition splendid; internal contact very exact.
164	Definition good.
165 166	Definition good.
167	Definition very bad.
168	Definition very good.
169 170	Very good.
171 172 173	Jupiter very low, but No. 171 considered very exact.
174 175 176	Definition splendid.
177 178 179	Definition very good. External contact may be a little too soon, as a little cirrus was passing in front of the planet. Internal contact very good.
180 181 182	Definition very sharp.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
183	May 10	C	I. Ec. R.	First seen	10 15 57·2	1 1 36·9	1 1 33	–0 4	200
184				Quite distinct	10 16 6·2	1 1 45·9	—	—	"
185				Full blaze	10 19 44·2	1 5 23·9	—	—	"
186	May 22	S	IV. Tr. E.	External contact	7 32 21·3	22 18 1·0	—	—	"
187	May 25	S	I. Tr. I.	External contact	7 52 21·9	22 38 1·6	—	—	"
188				About bisected	7 54 41·9	22 40 21·6	—	—	"
189				Internal contact	7 58 21·9	22 44 1·6	—	—	"
190	May 27	S	I. Sh. E.	Internal contact	5 50 16·9	20 35 56·6	—	—	"
191				Limb complete	5 53 16·9	20 38 56·6	—	—	"
192	May 30	S	II. Tr. I.	External contact	6 40 37·4	21 26 17·1	—	—	"
193				About bisected	6 42 47·4	21 28 27·1	—	—	"
194				Internal contact	6 46 52·4	21 32 32·1	—	—	"
195	June 1	S	II. Ec. R.	First seen	7 10 32·8	21 56 12·5	21 56 49	+ 0 37	"
196				Quite distinct	7 10 37·8	21 56 17·5	—	—	"
197				Full blaze	7 13 32·8	21 59 12·5	—	—	"
198	June 9	C	I. Oc. D.	External contact	8 53 54·5	23 39 34·2	—	—	"
199				About bisected	8 55 41·5	23 41 21·2	—	—	"
200				Last seen	8 57 4·5	23 42 44·2	—	—	"
201	June 10	S	I. Tr. I.	External contact	6 15 33·5	21 1 13·2	—	—	"
202				About bisected	6 17 28·5	21 3 8·2	—	—	"
203				Internal contact	6 20 18·5	21 5 58·2	—	—	"
204	"	S	I. Tr. E.	External contact	8 37 33·5	23 23 13·2	—	—	"
205	June 11	C	I. Ec. R.	First seen	6 54 8·4	21 39 48·1	21 39 37	–0 11	"
206				Quite distinct	6 54 12·9	21 39 52·6	—	—	"
207				Full blaze	6 57 40·9	21 43 20·6	—	—	"
208	"	C	III. Oc. R.	First seen	7 3 23·9	21 49 3·6	—	—	300
209				External contact	7 8 20·9	21 54 0·6	—	—	"
210	"	C	III. Ec. D.	Very faint	8 27 30·9	23 13 10·6	—	—	200
211				Last seen	8 27 42·9	23 13 22·6	23 10 18	–3 5	"

212	June 17	S	I. Tr. I.	External contact	8 12 48·9	22 58 28·6	—	—	125
213				Internal contact	8 18 8·9	23 3 48·6	—	—	"
214	July 6	C	III. Tr. I.	External contact	6 12 43·5	20 58 23·2	—	—	200
215				About bisected	6 16 26·5	21 2 6·2	—	—	"
216				Internal contact	6 22 31·5	21 8 11·2	—	—	"
217	July 12	C	I. Tr. E.	Internal contact	5 25 37·8	20 11 17·5	—	—	"
218				About bisected	5 27 37·8	20 13 17·5	—	—	"
219				External contact	5 29 47·8	20 15 27·5	—	—	"

REMARKS.

Ref. No.

183, 184, 185. I fancied I caught a glimpse at 10h. 15m. 53·2s. A.M.T., but could not be certain. At 10h. 15m. 57·2s. A.M.T., it was very faint indeed. Hazy near Jupiter.

186. Shortly before internal contact, the satellite was visible as an ill-defined black spot, very small and indistinct, the definition not being good. Then it became invisible and was not seen again until a glimpse of it was caught off the planet's limb at 7h. 25m. 50s. A.M.T. The external contact took place about the time noted (7h. 32m. 21·3s, A.M.T.), but the part of the satellite on the disc was totally invisible during the whole time of egress, and the observation is therefore not at all good; the limb of the planet also was woolly and ill-defined. After egress the satellite was very faint.

187, 188, 189. Definition bad.

190, 191. Definition fair. Observation not certain.

192. Considered good.

194. Through cloud; definition very bad; observation very uncertain.

195, 196, 197. Considered good.

198, 199, 200. Not good, but fairly so at times.

201, 202, 203. Definition splendid.

204. Through cloud; observation considered fair.

Ref. No.

205, 206, 207. Definition very good.

208, 209. This observation was rather peculiar. The definition was very sharp, especially with a power of 200. At the time noted as "first seen," the satellite appeared as an extremely faint dot on the planet's limb, and this observation was considered very exact, in fact, the satellite would not have been seen had not the definition been unusually good. About one minute later there was a most unmistakeable division between the satellite (which even then was a most minute speck of light) and the sharp limb of the planet. The satellite, however, became larger and larger, while the division remained the same. At the time noted as external contact the satellite ceased to increase in size, although then hardly as large apparently as I., which had just reappeared from Jupiter's shadow. From this time till 7h. 13m. 20s., A.M.T., the aspect of affairs remained apparently *unaltered*, the satellite undergoing no perceptible increase in size, and the division between it and the planet's limb remaining as fine as ever. At 7h. 13m. 20s., however, this division commenced to increase, but the satellite even then did not appear to be so bright as the first.—C., 300.

210, 211. Definition still good.

212, 213. Definition very bad; planet low down.

214, 215, 216. Definition good; limb very sharp at times. Internal contact considered very exact.

217, 218, 219. Fair.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1885.				h m s	h m s	h m s	m s	
220	November 1	C	III. Ec. D.	Very faint	16 6 52·0	6 52 31·7	—	—	125
221				Disappeared	16 6 55·0	6 52 34·7	6 49 17	– 3 18	"
222	"	C	I. Oc. R.	First seen	16 23 29·0	7 9 8·7	—	—	"
223				External contact	16 28 12·0	7 13 51·7	—	—	"
224	November 12	C	III. Tr. E.	Internal contact	16 37 13·5	7 22 53·2	—	—	200
225				About bisected	16 41 33·5	7 27 13·2	—	—	"
226				External contact	16 46 17·5	7 31 57·2	—	—	"
227	December 1	C	I. Ec. D.	Very faint	15 21 14·8	6 6 54·5	—	—	"
228				Disappeared	15 21 18·8	6 6 58·5	6 6 24	– 0 34	"
229	December 2	C	I. Tr. E.	Internal contact	15 47 11·3	6 32 51·0	—	—	"
230				About bisected	15 50 21·3	6 36 1·0	—	—	"
231				External contact	15 52 21·3	6 38 1·0	—	—	"
232	December 9	C	I. Tr. I.	External contact	15 27 37·2	6 13 16·9	—	—	120
233				About bisected	15 29 47·2	6 15 26·9	—	—	"
234				Internal contact	15 33 17·2	6 18 56·9	—	—	200
235	December 10	C	I. Oc. R.	First seen	15 7 29·4	5 53 9·1	—	—	"
236				About bisected	15 9 23·4	5 55 3·1	—	—	"
237				External contact	15 10 48·4	5 56 28·1	—	—	"
238	December 13	C	II. Ec. D.	Very faint	15 0 53·8	5 46 33·5	—	—	"
239				Disappeared	15 1 11·0	5 46 50·7	5 45 20	– 1 31	"
240	December 14	C	III. Ec. D.	Very faint	15 54 20·9	6 40 0·6	—	—	"
241				Disappeared	15 54 38·9	6 40 18·6	6 36 10	– 4 9	"
242	December 18	C	I. Tr. E.	Internal contact	14 6 30·0	4 52 9·7	—	—	125
243				About bisected	14 9 10·0	4 54 49·7	—	—	"
244				External contact	14 11 35·0	4 57 14·7	—	—	"
245	"	C	IV. Oc. R.	First seen	15 44 9·8	6 29 49·5	—	—	200
246				External contact	15 51 9·8	6 36 49·5	—	—	"
247	December 25	S	I. Tr. E.	Internal contact	16 1 12·8	6 46 52·5	—	—	125
248				External contact	16 4 59·8	6 50 39·5	—	—	"

REMARKS.

Ref. No.	
220 221	Definition pretty good.
222 223	Considered good.
224 225 226	Good.
227 228	Definition very good.
229 230 231	Definition variable ; cirrus about ; external contact considered good.
232 233 234	Not good.
235 236 237	Good ; definition of limb very sharp, but surface markings rather faint.
238 239	Definition very good.
240 241	Very good.
242 243 244	Not very good.
245 246	Definition good, but Cirrus about.
247 248	Definition very bad.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 55′ 38·5″ S.

1886.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
					h m s	h m s	h m s	m s	
1	Jan. 1	C	I. Tr. I.	External contact	15 37 27·8	6 23 7·5	—	—	125
2				Internal contact	15 41 17·8	6 26 57·5	—	—	"
3	Jan. 3	C	I. Tr. E.	Internal contact	12 20 44·2	3 6 23·9	—	—	"
4				About bisected	12 22 54·2	3 8 33·9	—	—	"
5				External contact	12 25 39·2	3 11 18·9	—	—	"
6	Jan. 9	S	I. Ec. D.	Still visible	13 43 28·6	4 29 8·3	—	—	200
7				Disappearance	13 43 33·6	4 29 13·3	4 28 21	– 0 52	"
8	Jan. 12	C	III. Oc. D.	External contact	12 27 59·0	3 13 38·7	—	—	125
9				About bisected	12 33 19·0	3 18 58·7	—	—	"
10				Last seen	12 38 58·0	3 24 37·7	—	—	"
11	"	C	III. Oc. R.	First seen	15 15 18·6	6 0 58·3	—	—	200
12				External contact	15 23 23·6	6 9 3·3	—	—	"
13	"	C	IV. Tr.	Ingress	14 46 38·6	5 32 18·3	—	—	"
14				Egress	16 2 58·6	6 48 38·3	—	—	"
15	Jan. 14	C	II. Ec. D.	Very faint	14 37 0·6	5 22 40·3	—	—	"
16				Disappearance	14 37 20·6	5 23 0·3	5 21 29	– 1 31	"
17	Jan. 16	C	II. Tr. E.	Internal contact	14 33 49·6	5 19 29·3	—	—	"
18				About bisected	14 35 39·6	5 21 19·3	—	—	"
19				External contact	14 37 29·6	5 23 9·3	—	—	"
20	"	C	I. Ec. D.	Very faint	15 36 17·6	6 21 57·3	—	—	"
21				Disappearance	15 36 31·6	6 22 11·3	6 21 20	– 0 51	"
22	Jan. 18	C	I. Oc. R.	First seen	13 23 25·1	4 9 4·8	—	—	"
23				External contact	13 26 35·1	4 12 14·8	—	—	"
24	Jan. 20	C	IV. Ec. D.	Very faint	13 43 49·1	4 29 28·8	—	—	"
25				Disappearance	13 45 30·1	4 31 9·8	4 37 40	+ 6 30	"
26	"	C	IV. Ec. R.	First seen	16 19 57·8	7 5 37·5	7 2 52	– 2 46	"
27				Quite distinct	16 20 41·8	7 6 21·5	—	—	"
28				Full blaze	16 30 38·8	7 16 18·5	—	—	"
29	Jan. 25	C	I. Ec. D.	Very faint	11 57 32·6	2 43 12·3	—	—	"
30				Disappearance	11 57 47·8	2 43 27·5	2 42 35	– 0 52	"

31	“	C	I. Oc. R.	First seen	15 12 6·3	5 57 46·0	—	—	“
32				External contact	15 15 36·3	6 1 16·0	—	—	“
33	Jan. 26	C	I. Tr. E.	About bisected	12 20 44·1	3 6 23·8	—	—	“
34				External contact	12 22 59·1	3 8 38·8	—	—	“
35	“	C	III. Ec. D.	Very faint	15 39 24·0	6 25 3·7	—	—	“
36				Disappearance	15 39 44·0	6 25 23·7	6 21 20	−4 4	“
37	Jan. 30	S	III. Tr. E.	Internal contact	12 4 29·0	2 50 8·7	—	—	125
38				External contact	12 13 34·0	2 59 13·7	—	—	“
39	Feb.1	S	I. Oc. R.	First seen	16 59 17·8	7 44 57·5	—	—	200
40				External contact	17 2 27·8	7 48 7·5	—	—	“
41	Feb. 2..............	S	I. Tr. I.	External contact	11 55 6·0	2 40 45·7	—	—	“
42				About bisected	11 57 51·0	2 43 30·7	—	—	“
43				Internal contact	11 59 41·0	2 45 20·7	—	—	“
44	“	S	I. Sh. E.	Internal contact	13 12 10·9	3 57 50·6	—	—	“
45				Still visible	13 14 11·9	3 59 51·6	—	—	“

REMARKS.

Ref. No.	
1 2	Very uncertain.
3 4 5	Pretty good, but planet very low down, and limb boiling a little.
8 9 10	Pretty good.
11 12	Definition good; external contact considered very exact.
13 14	This was not down in the *Nautical Almanac*, but the fourth satellite transited near the north pole of Jupiter, about half of the satellite being visible outside Jupiter's limb at mid-transit. Of course, since the direction of motion was so very oblique, the times noted as external contact for ingress and egress are only very approximate.
15 16	Very good.
17 18 19	Definition fair; observation considered good. N.B.—Much before the *Nautical Almanac* time.
20 21	Good.
22 23	Considered very good. Definition of limb very sharp.
24 25	Considered good. There was some thin cirrus about, but the light of the other satellites suffered no apparent diminution.
26 27 28	Good.
29 30	Pretty good.
31 32	Very good.
33 34	Fair; cloudy.
35 36	Good; little thin cloud about.
37 38	Definition fair at times, but very unsteady.
39 40	Very good. Soon after the satellite was first seen it appeared exactly like a transit egress; definition splendid, but, unfortunately, a cloud immediately came over the planet, and when it cleared away the satellite appeared as if filling a hole in disc, but at external contact the satellite was exactly tangential to the limb.
41 42 43	Definition very unsteady and planet boiling, rendering observation very uncertain.
44 45	“ Limb complete ” could not be taken, as the planet was too unsteady.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
46	Feb. 2..............	S	II. Tr. E.	Internal contact	14 6 5·8	4 51 45·5	—	—	200
47				About bisected	14 8 35·8	4 54 15·5	—	—	“
48				External contact	14 10 45·8	4 56 25·5	—	—	“
49	Feb. 3..............	S	I. Oc. R.	First seen	11 26 54·3	2 12 34·0	—	—	“
50				External contact	11 29 34·3	2 15 14·0	—	—	“
51	Feb. 6..............	S	III. Sh. E.	Internal contact	12 13 15·3	2 58 55·0	—	—	“
52				Still visible	12 20 50·3	3 6 30·0	—	—	“
53				Limb complete	12 21 0·3	3 6 40·0	—	—	“
54	“	S	III. Tr. I.	External contact	13 4 5·2	3 49 44·9	—	—	“
55				About bisected	13 10 15·2	3 55 54·9	—	—	“
56				Internal contact	13 16 20·2	4 1 59·9	—	—	“
57	‘	S	III. Tr. E.	Internal contact	15 37 9·9	6 22 49·6	—	—	“
58				About bisected	15 42 44·9	6 28 24·6	—	—	“
59				External contact	15 48 14·8	6 33 54·6	—	—	“
60	Feb. 8..............	S	II. Ec. D.	Still visible	11 41 50·7	2 27 30·4	—	—	“
61				Disappearance	11 41 52·7	2 27 32·4	2 26 1	–1 31	“
62	“	S	I. Ec. D.	Still visible	15 43 51·2	6 29 30·9	—	—	“
63				Disappearance	15 43 53·2	6 29 32·9	6 28 44	–0 49	“
64	“	S	II. Oc. R.	First seen	16 11 14·1	6 56 53·8	—	—	“
65				External contact	16 14 24·1	7 0 3·8	—	—	“
66	“	C	I. Sh. I.	First seen	12 53 25·1	3 39 4·8	—	—	“
67				Internal contact	12 56 12·1	3 41 51·8	—	—	“
68	Feb. 9..............	C	I. Tr. I.	External contact	13 42 33·0	4 28 12·7	—	—	“
69				About bisected	13 44 57·0	4 30 36·7	—	—	300
70				Internal contact	13 46 51·0	4 32 30·7	—	—	“
71	“	C	I. Sh. E.	Internal contact	15 5 41·9	5 51 21·6	—	—	“
72	“	C	I. Tr. E.	External contact	15 58 56·8	6 44 36·5	—	—	“
73	Feb. 10..............	C	I. Oc. R.	First seen	13 13 29·4	3 59 9·1	—	—	200
74				External contact	13 16 34·4	4 2 14·1	—	—	“
75	Feb. 13..............	S	III. Sh. I.	Limb indented	13 15 51·2	4 1 30·9	—	—	“
76				Internal contact	13 24 21·2	4 10 0·9	—	—	“
77	“	S	III. Tr. I.	External contact	16 32 25·8	7 18 5·5	—	—	“
78				About bisected	16 38 30·8	7 24 10·5	—	—	“
79				Internal contact	16 45 20·8	7 31 0·5	—	—	“
80	Feb. 15..............	S	II. Ec. D.	Still visible	14 16 58·0	5 2 37·7	—	—	125
81				Disappearance	14 17 1·0	5 2 40·7	5 1 52	–0 49	“
82	Feb. 16............	S	I. Sh. I.	Limb indented	14 46 37·3	5 32 17·0	—	—	200
83				Internal contact	14 53 13·3	5 38 53·0	—	—	“

84 85 86	"	S	I. Tr. I.	External contact About bisected Internal contact	15 28 28·3 15 30 53·3 15 34 8·3	6 14 8·0 6 16 33·0 6 19 48·0	— — —	— — —	" " "
87 88	Feb. 17.............	S	II. Tr. I.	External contact Internal contact	10 31 56·5 10 35 56·5	1 17 36·2 1 21 36·2	— —	— —	125 "
89 90	"	S	II. Sh. E.	Internal contact Limb complete	11 49 46·4 11 52 46·4	2 35 26·1 2 38 26·1	— —	— —	" "
91 92	"	S	I. Ec. D.	Still visible Disappearance	12 6 17·4 12 6 19·4	2 51 57·1 2 51 59·1	— 2 50 11	— − 1 48	" "
93 94	"	S	II. Tr. E.	About bisected External contact	13 12 0·2 13 14 36·2	3 57 39·9 4 0 15·9	— —	— —	" "
95 96	"	S	I. Oc. R.	First seen External contact	14 58 16·1 15 2 6·1	5 43 55·8 5 47 45·8	— —	— —	200 "
97 98	Feb. 18.............	S	I. Tr. E.	Internal contact External contact	0 6 25·2 0 10 30·2	2 52 4·9 2 56 9·9	— —	— —	" "

REMARKS.

Ref. No.	
46 47 48	Definition generally good, but planet became indistinct and blurred every now and then.
49 50	Time of " first seen " doubtful; external contact very good.
51 52 53	Definition generally very good. Shadow very far north.
54 55 56	Definition very good. Satellite is just on southern edge of north polar shading.
57 58 59	Observation very good. Definition mostly splendid.
60 61	Observation considered very good.
64 65	Good observation.
66 67	Good.
68 69 70	Very good.
71	Definition very good; external contact lost through clouds.
72	Definition very good; rest of observation lost through clouds.

Ref. No.	
73 74	Clouds about and definition variable, but on the whole good.
75 76	Internal contact doubtful; planet boiling at times.
77 78 79	Definition very variable; light south-easterly breeze.
80 81	Definition frightful.
82 83	Observation not very exact; limb unsteady and shadow very small, as small apparently as that of satellite II. usually is.
84 85 86	Definition of limb pretty good, but unsteady at times.
87 88	Planet very low, and seen through smoke haze, which prevented the observation from being very exact.
89	Fair.
90	Not very exact, the planet being seen through smoke and the limb boiling a little.
93 94	Definition good; bisection a little too soon, perhaps.
95 96	Definition mostly good. " First seen " probably a little late.
97 98	Definition generally very good; passing clouds at external contact.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
99	Feb. 20.............	S	III. Sh. I.	Limb indented	17 14 45·1	8 0 24·8	—	—	200
100				Internal contact	17 21 50·1	8 7 29·8	—	—	"
101	Feb. 22.............	S	II. Ec. D.	Still visible	16 53 29·6	7 39 9·3	—	—	"
102				Disappearance	16 53 33·6	7 39 13·3	7 37 54	– 1 19	"
103	Feb. 23.............	S	I. Tr. I.	External contact	17 12 51·3	7 58 31·0	—	—	125
104	Feb. 24.............	S	III. Oc. R.	External contact	12 38 38·8	3 24 18·5	—	—	200
105	"	S	II. Tr. I.	External contact	12 47 33·8	3 33 13·5	—	—	"
106				About bisected	12 49 38·8	3 35 18·5	—	—	"
107				Internal contact	12 52 33·8	3 38 13·5	—	—	"
108	"	S	I. Ec. D.	Very faint	13 58 30·6	4 44 10·3	—	—	"
109				Disappearance	13 58 33·6	4 44 13·3	4 43 27	– 0 46	"
110	Feb. 24.............	S	II. Sh. E.	Internal contact	14 22 58·6	5 8 38·3	—	—	
111				Limb complete	14 25 38·6	5 11 18·3	—	—	"
112	"	S	II. Tr. E.	Internal contact	15 25 33·4	6 11 13·1	—	—	"
113				About bisected	15 28 8·4	6 13 48·1	—	—	"
114				External contact	15 30 43·4	6 16 23·1	—	—	"
115	"	S	I. Oc. R.	First seen	16 43 3·3	7 28 43·0	—	—	"
116				External contact	16 47 8·3	7 32 48·0	—	—	"
117	Feb. 25.............	S	I. Tr. E.	External contact	13 57 21·0	4 43 0·7	—	—	"
118	Feb. 26.............	S	I. Oc. R.	External contact	11 13 33·9	1 59 13·6	—	—	125
119	March 5	C	I. Ec. D.	Very faint	10 19 54·4	1 5 34·1	—	—	"
120				Disappearance	10 20 0·4	1 5 40·1	1 5 9	– 0 31	"
121	"	C	II. Oc. R.	First seen	12 17 12·2	3 2 51·9	—	—	200
122				External contact	12 20 44·2	3 6 23·9	—	—	"
123	"	C	I. Oc. R.	First seen	12 53 49·1	3 39 28·8	—	—	"
124				External contact	12 57 44·1	3 43 23·8	—	—	"
125	March 6	C	I. Sh. E.	Internal contact	9 43 34·8	0 29 14·5	—	—	"
126				About bisected	9 44 57·8	0 30 37·5	—	—	"
127				Still visible	9 45 44·8	0 31 24·5	—	—	"
128				Limb complete	9 46 24·8	0 32 4·5	—	—	"
129	March 10	C	III. Ec. D.	Very faint	15 27 20·9	6 13 0·6	—	—	"
130				Disappearance	15 27 27·9	6 13 7·6	6 8 40	– 4 28	"
131	March 12	C	II. Ec. D.	Very faint	11 23 4·9	2 8 44·6	—	—	125
132				Disappearance	11 23 18·9	2 8 58·6	2 8 11	– 0 48	"
133	"	C	II. Oc. R.	First seen	14 33 3·7	5 18 43·4	—	—	"
134				External contact	14 36 48·7	5 22 28·4	—	—	"

135 136	“	C	I. Oc. R.	First seen External contact	14 37 36·7 14 39 39·7	5 23 16·4 5 25 19·4	— —	— —	“ “
137 138	March 13	C	I. Sh. E.	About bisected External contact	11 34 22·7 11 35 33·7	2 20 2·4 2 21 13·4	— —	— —	“ “
139 140 141	“	C	I. Tr. E.	Internal contact About bisected External contact	11 46 20·7 11 48 55·7 11 51 16·7	2 32 0·4 2 34 35·4 2 36 56·4	— — —	— — —	200 “ “
142 143	March 19	C	II. Ec. D.	Very faint Disappearance	13 59 57·0 14 0 2·0	4 45 36·7 4 45 41·7	— 4 44 48	— – 0 54	“ “
144 145	“	C	I. Ec. D.	Very faint Disappearance	14 7 2·0 14 7 14·0	4 52 41·7 4 52 53·7	— 4 52 16	— – 0 38	“ “
146 147 148	March 20	C	I. Tr. I.	External contact About bisected Internal contact	11 19 4·8 11 21 9·8 11 23 8·8	2 4 44·5 2 6 49·5 2 8 48·5	— — —	— — —	“ “ “

REMARKS.

Ref. No.	
99 100	Good observation. Definition rather variable, but splendid at times. Wind due south.
103	Cloudy for internal contact. Observation uncertain, clouds continuously passing over, and limb boiling dreadfully at times.
104	Definition generally good, but unsteady at times. The first instant of reappearance was missed.
105 106 107	Good.
110 111	Observation not very good.
112 113 114	Definition good at internal contact, but unsteady at external contact.
115 116	Definition of limb not good.
117	Not good; through cloud. Satellite invisible at times. Internal contact could not be seen on account of clouds.
118	Definition very bad, and clouds continually passing over; “first seen” phase hidden by cloud.
119 120	Definition very bad.
121 122	Definition variable. Observation considered good.
123 124	Not good.

Ref. No.	
125 126 127 128	Definition very good at times, but variable. Observation considered satisfactory.
129 130	Good.
131 132	Definition variable; very good and very bad alternately. Observation considered exact to a second or two.
133 134	Definition generally good.
135 136	Definition generally good, but “first seen” most likely late, as it emerged close to II.
137 138	Fair, but limb boiling slightly at times.
139 140 141	Pretty good. Internal contact may be a little early.
142 143 144 145	Definition very good at times, but variable. Observations considered good.
146 147 148	Considered good—internal contact especially. The definition, however, was not sufficiently steady to admit of seeing shadow distinctly unti about bisection of satellite, when it was noticed on its south polar edge.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
99	Feb. 20.............	S	III. Sh. I.	Limb indented	17 14 45·1	8 0 24·8	—	—	200
100				Internal contact	17 21 50·1	8 7 29·8	—	—	"
101	Feb. 22.............	S	II. Ec. D.	Still visible	16 53 29·6	7 39 9·3	—	—	"
102				Disappearance	16 53 33·6	7 39 13·3	7 37 54	– 1 19	"
103	Feb. 23.............	S	I. Tr. I.	External contact	17 12 51·3	7 58 31·0	—	—	125
104	Feb. 24.............	S	III. Oc. R.	External contact	12 38 38·8	3 24 18·5	—	—	200
105	"	S	II. Tr. I.	External contact	12 47 33·8	3 33 13·5	—	—	"
106				About bisected	12 49 38·8	3 35 18·5	—	—	"
107				Internal contact	12 52 33·8	3 38 13·5	—	—	"
108	"	S	I. Ec. D.	Very faint	13 58 30·6	4 44 10·3	—	—	"
109				Disappearance	13 58 33·6	4 44 13·3	4 43 27	– 0 46	"
110	Feb. 24.............	S	II. Sh. E.	Internal contact	14 22 58·6	5 8 38·3	—	—	
111				Limb complete	14 25 38·6	5 11 18·3	—	—	"
112	"	S	II. Tr. E.	Internal contact	15 25 33·4	6 11 13·1	—	—	"
113				About bisected	15 28 8·4	6 13 48·1	—	—	"
114				External contact	15 30 43·4	6 16 23·1	—	—	"
115	"	S	I. Oc. R.	First seen	16 43 3·3	7 28 43·0	—	—	"
116				External contact	16 47 8·3	7 32 48·0	—	—	"
117	Feb. 25.............	S	I. Tr. E.	External contact	13 57 21·0	4 43 0·7	—	—	"
118	Feb. 26.............	S	I. Oc. R.	External contact	11 13 33·9	1 59 13·6	—	—	125
119	March 5	C	I. Ec. D.	Very faint	10 19 54·4	1 5 34·1	—	—	"
120				Disappearance	10 20 0·4	1 5 40·1	1 5 9	– 0 31	"
121	"	C	II. Oc. R.	First seen	12 17 12·2	3 2 51·9	—	—	200
122				External contact	12 20 44·2	3 6 23·9	—	—	"
123	"	C	I. Oc. R.	First seen	12 53 49·1	3 39 28·8	—	—	"
124				External contact	12 57 44·1	3 43 23·8	—	—	"
125	March 6	C	I. Sh. E.	Internal contact	9 43 34·8	0 29 14·5	—	—	"
126				About bisected	9 44 57·8	0 30 37·5	—	—	"
127				Still visible	9 45 44·8	0 31 24·5	—	—	"
128				Limb complete	9 46 24·8	0 32 4·5	—	—	"
129	March 10	C	III. Ec. D.	Very faint	15 27 20·9	6 13 0·6	—	—	"
130				Disappearance	15 27 27·9	6 13 7·6	6 8 40	– 4 28	"
131	March 12	C	II. Ec. D.	Very faint	11 23 4·9	2 8 44·6	—	—	125
132				Disappearance	11 23 18·9	2 8 58·6	2 8 11	– 0 48	"
133	"	C	II. Oc. R.	First seen	14 33 3·7	5 18 43·4	—	—	"
134				External contact	14 36 48·7	5 22 28·4	—	—	"

135	"	C	I. Oc. R.	First seen	14 37 36·7	5 23 16·4	—	—	"
136				External contact	14 39 39·7	5 25 19·4	—	—	"
137	March 13	C	I. Sh. E.	About bisected	11 34 22·7	2 20 2·4	—	—	"
138				External contact	11 35 33·7	2 21 13·4	—	—	"
139	"	C	I. Tr. E.	Internal contact	11 46 20·7	2 32 0·4	—	—	200
140				About bisected	11 48 55·7	2 34 35·4	—	—	"
141				External contact	11 51 16·7	2 36 56·4	—	—	"
142	March 19	C	II. Ec. D.	Very faint	13 59 57·0	4 45 36·7	—	—	"
143				Disappearance	14 0 2·0	4 45 41·7	4 44 48	– 0 54	"
144	"	C	I. Ec. D.	Very faint	14 7 2·0	4 52 41·7	—	—	"
145				Disappearance	14 7 14·0	4 52 53·7	4 52 16	– 0 38	"
146	March 20	C	I. Tr. I.	External contact	11 19 4·8	2 4 44·5	—	—	"
147				About bisected	11 21 9·8	2 6 49·5	—	—	"
148				Internal contact	11 23 8·8	2 8 48·5	—	—	"

REMARKS.

Ref. No.	
99 100	Good observation. Definition rather variable, but splendid at times. Wind due south.
103	Cloudy for internal contact. Observation uncertain, clouds continuously passing over, and limb boiling dreadfully at times.
104	Definition generally good, but unsteady at times. The first instant of reappearance was missed.
105 106 107	Good.
110 111	Observation not very good.
112 113 114	Definition good at internal contact, but unsteady at external contact.
115 116	Definition of limb not good.
117	Not good; through cloud. Satellite invisible at times. Internal contact could not be seen on account of clouds.
118	Definition very bad, and clouds continually passing over; "first seen" phase hidden by cloud.
119 120	Definition very bad.
121 122	Definition variable. Observation considered good.
123 124	Not good.
125 126 127 128	Definition very good at times, but variable. Observation considered satisfactory.
129 130	Good.
131 132	Definition variable; very good and very bad alternately. Observation considered exact to a second or two.
133 134	Definition generally good.
135 136	Definition generally good, but "first seen" most likely late, as it emerged close to II.
137 138	Fair, but limb boiling slightly at times.
139 140 141	Pretty good. Internal contact may be a little early.
142 143 144 145	Definition very good at times, but variable. Observations considered good.
146 147 148	Considered good—internal contact especially. The definition, however, was not sufficiently steady to admit of seeing shadow distinctly unti about bisection of satellite, when it was noticed on its south polar edge.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
149	March 20	C	I. Tr. E.	Internal contact	13 32 5·6	4 17 45·3	—	—	200
150				About bisected	13 33 40·6	4 19 20·3	—	—	“
151				External contact	13 35 58·6	4 21 38·3	—	—	“
152	March 21	C	I. Oc. D.	External contact	8 31 2·7	23 16 42·4	—	—	125
153				About bisected	8 33 2·7	23 18 42·4	—	—	“
154				Internal contact	8 34 42·7	23 20 22·4	—	—	“
155	“	C	II. Tr. I.	External contact	8 35 10·7	23 20 50·4	—	—	“
156				About bisected	8 37 22·7	23 23 2·4	—	—	“
157				Internal contact	8 40 12·7	23 25 52·4	—	—	“
158	“	C	III. Tr. I.	External contact	9 10 47·6	23 56 27·3	—	—	“
159				About bisected	9 16 2·6	0 1 42·3	—	—	“
160				Internal contact	9 22 12·6	0 7 52·3	—	—	“
161	“	C	I. Oc. R.	External contact	10 49 27·4	1 35 7·1	—	—	200
162	“	C	II. Tr. E.	Internal contact	11 16 14·4	2 1 54·1	—	—	“
163				About bisected	11 18 22·4	2 4 2·1	—	—	“
164				External contact	11 20 42·4	2 6 22·1	—	—	“
165	“	C	III. Tr. E.	External contact	11 58 39·3	2 44 19·0	—	—	“
166	“	C	III. Sh. E.	About bisected	11 57 15·3	2 42 55·0	—	—	200
167				Limb complete	12 2 1·3	2 47 41·0	—	—	“
168	March 26	C	I. Oc. D.	External contact	15 49 20·6	6 35 0·3	—	—	125
169				About bisected	15 52 0·6	6 37 40·3	—	—	“
170				Last seen	15 53 44·6	6 39 24·3	—	—	“
171	“	C	II. Oc. D.	External contact	16 17 41·5	7 3 21·2	—	—	“
172				About bisected	16 20 20·5	7 6 0·2	—	—	“
173				Last seen	16 22 23·5	7 8 3·2	—	—	“
174	March 28	C	I. Oc. D.	External contact	10 16 35·2	1 2 14·9	—	—	200
175				About bisected	10 18 30·2	1 4 9·9	—	—	“
176				Last seen	10 19 55·2	1 5 34·9	—	—	“
177	“	C	II. Tr. I.	External contact	10 49 28·1	1 35 7·8	—	—	“
178				About bisected	10 51 25·1	1 37 4·8	—	—	“
179				Internal contact	10 53 30·1	1 39 9·8	—	—	“
180	“	C	II. Sh. I.	First seen	11 9 27·1	1 55 6·8	—	—	“
181				Internal contact	11 12 40·1	1 58 19·8	—	—	“
182	“	C	III. Tr. I.	External contact	12 28 4·9	3 13 44·6	—	—	“
183				About bisected	12 33 4·9	3 18 44·6	—	—	“
184				Internal contact	12 37 59·9	3 23 39·6	—	—	“

185	“	C	I. Ec. R.	First seen	12 39 46·4	3 25 26·1	3 25 29	+ 0 3	“
186				Quite distinct	12 39 54·9	3 25 34·6	—	—	“
187				Full blaze	12 43 54·9	3 29 34·6	—	—	“
188	“	C	III. Sh. I.	First seen	13 3 54·8	3 49 34·5	—	—	“
189				About bisected	13 6 54·8	3 52 34·5	—	—	“
190				Internal contact	13 11 14·8	3 56 54·5	—	—	“
191	March 29	C	I. Tr. E.	Internal contact	9 42 13·2	0 27 52·9	—	—	“
192				About bisected	9 44 12·2	0 29 51·9	—	—	“
193				External contact	9 46 38·2	0 32 17·9	—	—	“
194	“	C	I. Sh. E.	Internal contact	9 54 16·2	0 39 55·9	—	—	“
195				Still visible	9 55 50·2	0 41 29·9	—	—	“
196				Limb complete	9 56 55·2	0 42 34·9	—	—	“
197	April 5	S	I. Tr. E.	Internal contact	11 26 32·6	2 12 12·3	—	—	“
198				About bisected	11 28 32·6	2 14 12·3	—	—	“
199				External contact	11 30 37·6	2 16 17·3	—	—	“

REMARKS.

Ref. No.	
149 150 151	Pretty good.
152 153 154	Not good; planet rather low down, and clouds about.
155 156 157	Not good; planet rather low down and clouds about. Internal contact considered pretty exact.
158 159 160	Pretty good. The satellite was overlapping the north following quadrant of the shadow.
161	Considered good; clouds about.
162 163 164	Good. Shadow phases almost simultaneous.
165	Pretty good.
166 167	Pretty good.
168 169 170	Good—disappearance especially.
171 172 173	Pretty good.

Ref. No.	
174 175 176	Pretty good.
177 178 179	Good.
180 181	Considered very good.
182 183 184	Good.
185 186 187	Good.
188 189 190	Good.
191 192 193	Pretty good, but somewhat interfered with by clouds.
194 195 196	Pretty good.
197 198 199	Definition splendid.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
200	April 5	S	I. Sh. E.	Internal contact	11 48 32·5	2 34 12·2	—	—	200
201				limb indented	11 51 37·5	2 37 17·2	—	—	"
202				Limb complete	11 51 47·5	2 37 27·2	—	—	"
203	April 6	S	II. Oc. D.	External contact	7 44 15·0	22 29 54·7	—	—	"
204				Still visible	7 47 10·0	22 32 49·7	—	—	"
205				Disappearance	7 47 20·0	22 32 59·7	—	—	"
206	"	S	I. Ec. R.	First seen	9 1 49·9	23 47 29·6	23 47 49	+ 0 19	"
207				Quite distinct	9 1 54·9	23 47 34·6	—	—	"
208	"	S	II. Ec. R.	First seen	11 15 14·6	2 0 54·3	2 1 41	+ 0 47	"
209				Quite distinct	11 15 19·6	2 0 59·3	—	—	"
210				Full blaze	11 18 24·6	2 4 4·3	—	—	"
211	April 8	S	III. Ec. R.	First seen	10 3 12·3	0 48 52·0	0 48 45	– 0 7	125
212				Plainly visible	10 3 16·3	0 48 56·0	—	—	"
213				Full blaze	10 10 14·3	0 55 54·0	—	—	"
214	April 11	S	I. Oc. D.	External contact	13 45 16·6	4 30 56·3	—	—	200
215				Still visible	13 48 51·6	4 34 31·3	—	—	"
216	April 12	S	I. Tr. I.	External contact	10 57 59·6	1 43 39·3	—	—	"
217				About bisected	11 0 34·6	1 46 14·3	—	—	"
218				Internal contact	11 3 29·6	1 49 9·3	—	—	"
219	"	S	I. Sh. I.	First seen	11 30 29·6	2 16 9·3	—	—	"
220				Internal contact	11 33 19·6	2 18 59·3	—	—	"
221	April 13	S	I. Oc. D.	External contact	8 11 17·4	22 56 57·1	—	—	"
222				Still visible	8 13 33·4	22 59 13·1	—	—	"
223	"	S	II. Oc. D.	External contact	10 1 52·2	0 47 31·9	—	—	"
224	"	S	I. Ec. R.	First seen	10 55 53·1	1 41 32·8	1 41 48	+ 0 15	"
225				Plainly visible	10 55 56·1	1 41 35·8	—	—	"
226				Full blaze	10 59 47·1	1 45 26·8	—	—	"
227	April 13	S	II. Ec. R.	First glimpsed	13 52 3·8	4 37 43·5	4 38 25	+ 0 42	125
228				Plainly visible	13 52 11·8	4 37 51·5	—	—	"
229	April 14	C	IV. Ec. D.	Very faint	8 2 1·2	22 47 40·9	—	—	"
230				Disappearance	8 3 40·2	22 49 19·9	22 59 38	+10 18	"
231	"	C	IV. Ec. R.	First seen, very faint	9 21 16·9	0 6 56·6	0 1 5	– 5 52	"
232				Plainly visible	9 24 10·7	0 9 50·4	—	—	"
233	April 15	S	III. Oc. D.	External contact	8 54 15·7	23 39 55·4	—	—	"
234				Still visible	9 0 20·7	23 46 0·4	—	—	"
235				Limb complete	9 0 50·7	23 46 30·4	—	—	"
236	"	S	III. Ec. R.	First glimpsed	14 0 46·0	4 46 25·7	4 46 15	– 0 11	"
237				Plainly visible	14 1 15·0	4 46 54·7	—	—	"

238				Full blaze	14 9 5·0	4 54 44·7	—	—	"
239	April 19	S	I. Tr. I.	External contact	12 44 7·0	3 29 46·7	—	—	200
240				About bisected	12 46 12·0	3 31 51·7	—	—	"
241				Internal contact	12 49 27·0	3 35 6·7	—	—	"
242	April 20	S	I. Oc. D.	External contact	9 55 9·4	0 40 49·1	—	—	"
243				Still visible	9 59 15·4	0 44 55·1	—	—	"
244				Disappearance	9 59 29·4	0 45 9·1	—	—	"
245	"	S	II. Oc. D.	External contact	12 19 29·1	3 5 8·8	—	—	"
246				About bisected	12 21 39·1	3 7 18·8	—	—	"
247				Still visible	12 22 55·1	3 8 34·8	—	—	"
248				Disappearance	12 23 14·1	3 8 53·8	—	—	"
249	"	S	I. Ec. R.	First seen	12 49 59·1	3 35 38·8	3 35 56	+ 0 17	"
250				Plainly visible	12 50 4·1	3 35 43·8	—	—	"
251				Full blaze	12 54 24·1	3 40 3·8	—	—	"

REMARKS.

Ref. No.	
200 201 202	Definition good.
203 204 205	Definition of limb unsteady, planet being rather low down, but observation very fair.
206 207	Definition of limb very good.
208 209 210	Definition good.
211 212 213	Good observation.
214 215	At the time of " still visible " thin cloud came up over the planet and destroyed the definition, which had been good, and the satellite was not seen again.
216 217 218	Definition good. External contact may be a little early.
219 220	Definition good.
221 222	Not good. The time of final disappearance could not be taken, the definition being too bad.
223	Not good; definition bad. Disappearance could not be taken.
224	Very good.

Ref. No.	
227 228	Definition very bad.
229 230	Definition variable, but observation considered good. It was barely visible at first time, and even at 7·30 p.m. was much fainter than either of the other satellites.
231 232	Considered good. The satellite was observed by S. with an 8½in. reflector as plainly visible at 9h. 20m. 48·5s.
233 234 235	Definition generally very bad, and observation unreliable.
236 237 238	Definition very bad indeed.
239 240 241	Definition pretty good at moment of external contact, which is considered very exact, but immediately after clouds came over the planet and definition got bad, and the internal contact is doubtful, the satellite being hardly visible.
242 243 244	Definition fair, and observation considered very good.
245 246 247 248	External contact very good; limb boiling slightly at disappearance of satellite.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
200	April 5	S	I. Sh. E.	Internal contact	11 48 32·5	2 34 12·2	—	—	200
201				limb indented	11 51 37·5	2 37 17·2	—	—	"
202				Limb complete	11 51 47·5	2 37 27·2	—	—	"
203	April 6	S	II. Oc. D.	External contact	7 44 15·0	22 29 54·7	—	—	"
204				Still visible	7 47 10·0	22 32 49·7	—	—	"
205				Disappearance	7 47 20·0	22 32 59·7	—	—	"
206	"	S	I. Ec. R.	First seen	9 1 49·9	23 47 29·6	23 47 49	+ 0 19	"
207				Quite distinct	9 1 54·9	23 47 34·6	—	—	"
208	"	S	II. Ec. R.	First seen	11 15 14·6	2 0 54·3	2 1 41	+ 0 47	"
209				Quite distinct	11 15 19·6	2 0 59·3	—	—	"
210				Full blaze	11 18 24·6	2 4 4·3	—	—	"
211	April 8	S	III. Ec. R.	First seen	10 3 12·3	0 48 52·0	0 48 45	− 0 7	125
212				Plainly visible	10 3 16·3	0 48 56·0	—	—	"
213				Full blaze	10 10 14·3	0 55 54·0	—	—	"
214	April 11	S	I. Oc. D.	External contact	13 45 16·6	4 30 56·3	—	—	200
215				Still visible	13 48 51·6	4 34 31·3	—	—	"
216	April 12	S	I. Tr. I.	External contact	10 57 59·6	1 43 39·3	—	—	"
217				About bisected	11 0 34·6	1 46 14·3	—	—	"
218				Internal contact	11 3 29·6	1 49 9·3	—	—	"
219	"	S	I. Sh. I.	First seen	11 30 29·6	2 16 9·3	—	—	"
220				Internal contact	11 33 19·6	2 18 59·3	—	—	"
221	April 13	S	I. Oc. D.	External contact	8 11 17·4	22 56 57·1	—	—	"
222				Still visible	8 13 33·4	22 59 13·1	—	—	"
223	"	S	II. Oc. D.	External contact	10 1 52·2	0 47 31·9	—	—	"
224	"	S	I. Ec. R.	First seen	10 55 53·1	1 41 32·8	1 41 48	+ 0 15	"
225				Plainly visible	10 55 56·1	1 41 35·8	—	—	"
226				Full blaze	10 59 47·1	1 45 26·8	—	—	"
227	April 13	S	II. Ec. R.	First glimpsed	13 52 3·8	4 37 43·5	4 38 25	+ 0 42	125
228				Plainly visible	13 52 11·8	4 37 51·5	—	—	"
229	April 14	C	IV. Ec. D.	Very faint	8 2 1·2	22 47 40·9	—	—	"
230				Disappearance	8 3 40·2	22 49 19·9	22 59 38	+10 18	"
231	"	C	IV. Ec. R.	First seen, very faint	9 21 16·9	0 6 56·6	0 1 5	− 5 52	"
232				Plainly visible	9 24 10·7	0 9 50·4	—	—	"
233	April 15	S	III. Oc. D.	External contact	8 54 15·7	23 39 55·4	—	—	"
234				Still visible	9 0 20·7	23 46 0·4	—	—	"
235				Limb complete	9 0 50·7	23 46 30·4	—	—	"
236	"	S	III. Ec. R.	First glimpsed	14 0 46·0	4 46 25·7	4 46 15	− 0 11	"
237				Plainly visible	14 1 15·0	4 46 54·7	—	—	"

238				Full blaze	14 9 5·0	4 54 44·7	—	—	“
239	April 19	S	I. Tr. I.	External contact	12 44 7·0	3 29 46·7	—	—	200
240				About bisected	12 46 12·0	3 31 51·7	—	—	“
241				Internal contact	12 49 27·0	3 35 6·7	—	—	“
242	April 20	S	I. Oc. D.	External contact	9 55 9·4	0 40 49·1	—	—	“
243				Still visible	9 59 15·4	0 44 55·1	—	—	“
244				Disappearance	9 59 29·4	0 45 9·1	—	—	“
245	“	S	II. Oc. D.	External contact	12 19 29·1	3 5 8·8	—	—	“
246				About bisected	12 21 39·1	3 7 18·8	—	—	“
247				Still visible	12 22 55·1	3 8 34·8	—	—	“
248				Disappearance	12 23 14·1	3 8 53·8	—	—	“
249	“	S	I. Ec. R.	First seen	12 49 59·1	3 35 38·8	3 35 56	+ 0 17	“
250				Plainly visible	12 50 4·1	3 35 43·8	—	—	“
251				Full blaze	12 54 24·1	3 40 3·8	—	—	“

REMARKS.

Ref. No.	
200 201 202	Definition good.
203 204 205	Definition of limb unsteady, planet being rather low down, but observation very fair.
206 207	Definition of limb very good.
208 209 210	Definition good.
211 212 213	Good observation.
214 215	At the time of “ still visible ” thin cloud came up over the planet and destroyed the definition, which had been good, and the satellite was not seen again.
216 217 218	Definition good. External contact may be a little early.
219 220	Definition good.
221 222	Not good. The time of final disappearance could not be taken, the definition being too bad.
223	Not good; definition bad. Disappearance could not be taken.
224	Very good.
227 228	Definition very bad.
229 230	Definition variable, but observation considered good. It was barely visible at first time, and even at 7·30 p.m. was much fainter than either of the other satellites.
231 232	Considered good. The satellite was observed by S. with an 8½in. reflector as plainly visible at 9h. 20m. 48·5s.
233 234 235	Definition generally very bad, and observation unreliable.
236 237 238	Definition very bad indeed.
239 240 241	Definition pretty good at moment of external contact, which is considered very exact, but immediately after clouds came over the planet and definition got bad, and the internal contact is doubtful, the satellite being hardly visible.
242 243 244	Definition fair, and observation considered very good.
245 246 247 248	External contact very good; limb boiling slightly at disappearance of satellite.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
200	April 5 …………	S	I. Sh. E.	Internal contact	11 48 32·5	2 34 12·2	—	—	200
201				limb indented	11 51 37·5	2 37 17·2	—	—	"
202				Limb complete	11 51 47·5	2 37 27·2	—	—	"
203	April 6 …………	S	II. Oc. D.	External contact	7 44 15·0	22 29 54·7	—	—	"
204				Still visible	7 47 10·0	22 32 49·7	—	—	"
205				Disappearance	7 47 20·0	22 32 59·7	—	—	"
206	" …………	S	I. Ec. R.	First seen	9 1 49·9	23 47 29·6	23 47 49	+ 0 19	"
207				Quite distinct	9 1 54·9	23 47 34·6	—	—	"
208	" …………	S	II. Ec. R.	First seen	11 15 14·6	2 0 54·3	2 1 41	+ 0 47	"
209				Quite distinct	11 15 19·6	2 0 59·3	—	—	"
210				Full blaze	11 18 24·6	2 4 4·3	—	—	"
211	April 8 …………	S	III. Ec. R.	First seen	10 3 12·3	0 48 52·0	0 48 45	− 0 7	125
212				Plainly visible	10 3 16·3	0 48 56·0	—	—	"
213				Full blaze	10 10 14·3	0 55 54·0	—	—	"
214	April 11 …………	S	I. Oc. D.	External contact	13 45 16·6	4 30 56·3	—	—	200
215				Still visible	13 48 51·6	4 34 31·3	—	—	"
216	April 12 …………	S	I. Tr. I.	External contact	10 57 59·6	1 43 39·3	—	—	"
217				About bisected	11 0 34·6	1 46 14·3	—	—	"
218				Internal contact	11 3 29·6	1 49 9·3	—	—	"
219	" …………	S	I. Sh. I.	First seen	11 30 29·6	2 16 9·3	—	—	"
220				Internal contact	11 33 19·6	2 18 59·3	—	—	"
221	April 13 …………	S	I. Oc. D.	External contact	8 11 17·4	22 56 57·1	—	—	"
222				Still visible	8 13 33·4	22 59 13·1	—	—	"
223	" …………	S	II. Oc. D.	External contact	10 1 52·2	0 47 31·9	—	—	"
224	" …………	S	I. Ec. R.	First seen	10 55 53·1	1 41 32·8	1 41 48	+ 0 15	"
225				Plainly visible	10 55 56·1	1 41 35·8	—	—	"
226				Full blaze	10 59 47·1	1 45 26·8	—	—	"
227	April 13 …………	S	II. Ec. R.	First glimpsed	13 52 3·8	4 37 43·5	4 38 25	+ 0 42	125
228				Plainly visible	13 52 11·8	4 37 51·5	—	—	"
229	April 14 …………	C	IV. Ec. D.	Very faint	8 2 1·2	22 47 40·9	—	—	"
230				Disappearance	8 3 40·2	22 49 19·9	22 59 38	+10 18	"
231	" …………	C	IV. Ec. R.	First seen, very faint	9 21 16·9	0 6 56·6	0 1 5	− 5 52	"
232				Plainly visible	9 24 10·7	0 9 50·4	—	—	"
233	April 15 .. ………	S	III. Oc. D.	External contact	8 54 15·7	23 39 55·4	—	—	"
234				Still visible	9 0 20·7	23 46 0·4	—	—	"
235				Limb complete	9 0 50·7	23 46 30·4	—	—	"
236	" …………	S	III. Ec. R.	First glimpsed	14 0 46·0	4 46 25·7	4 46 15	− 0 11	"
237				Plainly visible	14 1 15·0	4 46 54·7	—	—	"

238				Full blaze	14 9 5·0	4 54 44·7	—	—	“
239	April 19	S	I. Tr. I.	External contact	12 44 7·0	3 29 46·7	—	—	200
240				About bisected	12 46 12·0	3 31 51·7	—	—	“
241				Internal contact	12 49 27·0	3 35 6·7	—	—	“
242	April 20	S	I. Oc. D.	External contact	9 55 9·4	0 40 49·1	—	—	“
243				Still visible	9 59 15·4	0 44 55·1	—	—	“
244				Disappearance	9 59 29·4	0 45 9·1	—	—	“
245	“	S	II. Oc. D.	External contact	12 19 29·1	3 5 8·8	—	—	“
246				About bisected	12 21 39·1	3 7 18·8	—	—	“
247				Still visible	12 22 55·1	3 8 34·8	—	—	“
248				Disappearance	12 23 14·1	3 8 53·8	—	—	“
249	“	S	I. Ec. R.	First seen	12 49 59·1	3 35 38·8	3 35 56	+ 0 17	“
250				Plainly visible	12 50 4·1	3 35 43·8	—	—	“
251				Full blaze	12 54 24·1	3 40 3·8	—	—	“

REMARKS.

Ref. No.
200
201 Definition good.
202
203 Definition of limb unsteady, planet being rather low down, but
204 observation very fair.
205
206 Definition of limb very good.
207
208
209 Definition good.
210
211
212 Good observation.
213
214 At the time of “ still visible ” thin cloud came up over the planet and
215 destroyed the definition, which had been good, and the satellite was not seen again.
216
217 Definition good. External contact may be a little early.
218
219 Definition good.
220
221 Not good. The time of final disappearance could not be taken, the
222 definition being too bad.
223 Not good; definition bad. Disappearance could not be taken.
224 Very good.

Ref. No.
227 Definition very bad.
228
229 Definition variable, but observation considered good. It was barely
230 visible at first time, and even at 7·30 p.m. was much fainter than either of the other satellites.
231 Considered good. The satellite was observed by S. with an 8½in·
232 reflector as plainly visible at 9h. 20m. 48·5s.
233
234 Definition generally very bad, and observation unreliable.
235
236
237 Definition very bad indeed.
238
239 Definition pretty good at moment of external contact, which is considered very exact, but immediately after clouds came over the
240 planet and definition got bad, and the internal contact is doubtful,
241 the satellite being hardly visible.
242
243 Definition fair, and observation considered very good.
244
245
246 External contact very good; limb boiling slightly at disappearance
247 of satellite.
248

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
252	April 22	S	III. Oc. D.	External contact	12 15 8·2	3 0 47·9	—	—	200
253				About bisected	12 18 48·2	3 4 27·9		—	"
254				Still visible	12 23 18·2	3 8 57·9	—	—	"
255				Still visible	12 23 43·2	3 9 22·9	—	—	"
256				Disappearance	12 24 8·2	3 9 47·9	—	—	"
257	April 26	S	I. Tr. I.	External contact	14 31 28·7	5 17 8·4	—	—	125
258				About bisected	14 33 38·7	5 19 18·4	—	—	"
259				Internal contact	14 36 53·7	5 22 33·4	—	—	"
260	April 27	S	I. Oc. D.	External contact	11 42 40·8	2 28 20·5	—	—	200
261				Still visible	11 45 13·8	2 30 53·5	—	—	"
262				Disappearance	11 45 55·8	2 31 35·5	—	—	"
263	April 28	S	I. Tr. I.	External contact	8 58 23·9	23 44 3·6	—	—	"
264				About bisected	9 0 38·9	23 46 18·6	—	—	"
265				Internal contact	9 2 58·9	23 48 38·6	—	—	"
266	"	S	I. Sh. I.	First seen	9 48 59·8	0 34 39·5	—	—	"
267				Internal contact	9 51 53·8	0 37 33·5	—	—	"
268	"	S	I. Tr. E.	Internal contact	11 11 43·7	1 57 23·4	—	—	"
269				About bisected	11 13 33·7	1 59 13·4	—	—	"
270				External contact	11 15 48·7	2 1 28·4	—	—	"
271	"	S	I. Sh. E.	Internal contact	12 1 3·6	2 46 43·3	—	—	"
272	April 29	S	I. Oc. D.	External contact	6 9 27·1	20 55 6·8	—	—	"
273				Still visible	6 12 12·1	20 57 51·8	—	—	"
274				Disappearance	6 12 37·1	20 58 16·8	—	—	"
275	"	C	II. Tr. I.	External contact	8 59 27·8	23 45 7·5	—	—	"
276				About bisected	9 2 11·8	23 47 51·5	—	—	"
277				Internal contact	9 5 43·8	23 51 23·5	—	—	"
278	"	C	I. Ec. R.	First seen	9 12 56·0	23 58 35·7	23 58 43	+ 0 7	"
279				Quite distinct	9 12 59·8	23 58 39·5	—	—	"
280				Full blaze	9 17 1·8	24 2 41·5	—	—	"
281	"	S	II. Sh. I.	First seen	10 42 51·7	1 28 31·4	—	—	"
282				Internal contact	10 46 1·7	1 31 41·4	—	—	"
283	"	S	II. Tr. E.	Internal contact	11 42 46·6	2 28 26·3	—	—	"
284				About bisected	11 45 6·6	2 30 46·3	—	—	"
285				External contact	11 48 21·6	2 34 1·3	—	—	"
286	May 3	S	III. Tr. E.	Internal contact	8 6 30·4	22 52 10·1	—	—	"
287				External contact	8 15 43·9	23 1 23·6	—	—	"
288	"	S	III. Sh. I.	First seen	8 59 6·7	23 44 46·4	—	—	"
289				Internal contact	9 7 0·4	23 52 40·1	—	—	"

290	"	C	III. Sh. E.	Last seen	11 50 31·3	2 36 11·0	—	—	125
291	May 5	C	I. Tr. I.	External contact	10 46 51·7	1 32 31·4	—	—	200
292				About bisected	10 48 57·7	1 34 37·4	—	—	"
293				Internal contact	10 51 17·7	1 36 57·4	—	—	"
294	May 6	C	I. Ec. R.	First seen	11 7 24·5	1 53 4·2	1 53 6	+ 0 2	"
295				Quite distinct	11 7 28·0	1 53 7·7	—	—	"
296				Full blaze	11 11 3·0	1 56 42·7	—	—	"
297	"	C	II. Tr. I.	External contact	11 19 19·5	2 4 59·2	—	—	"
298				About bisected	11 22 28·5	2 8 8·2	—	—	"
299				Internal contact	11 26 0·0	2 11 39·7	—	—	125

REMARKS.

Ref. No.	
252 253 254 255 256	Definition bad at external contact, but after that the wind increased in strength, and the definition became very good. At the first time given for "still visible" the satellite itself could not be distinguished, but there appeared to be a slight hump on the planet's limb, and 25 secs. later there still appeared a slight hump, or rather corner. The satellite was bright and well defined, but the part hidden by the planet was totally invisible.
257 258 259	The planet was only about 10° above the horizon, and the limb was boiling dreadfully, but observation is fairly good.
260 261 262	Definition pretty fair for external contact, but very bad afterwards. At the time given for "still visible" the limb ceased boiling for an instant, but was bad again till 42secs. after, when it got slightly better, but not at all good, and the satellite could not then be seen.
263 264 265	Definition of limb and satellite very good.
266 267	Definition very good at times, but variable.
268 269 270	Definition fair.
271	Limb woolly and observation not good. Time of "limb complete" could not be obtained. Shadow very small, though at ingress it was large and distinct.
272 273 274	Definition generally good.

Ref. No.	
275 276 277	Definition variable; not good. Internal contact pretty exact.
278 279 280	Considered good.
281 282	Not very reliable; definition not good.
283 284 285	Definition fair; good at times. The satellite appeared very small, and could hardly be seen before internal contact. External contact considered good.
286 287	After internal contact clouds came up and prevented bisection from being taken, but cleared away before external contact. The satellite at internal contact appeared a milky white, but at 6h. 45m., when near mid-transit, it was very dark, almost black, and very conspicuous. It remained dark till 7·30 p.m. at least.
288 289	Very fair observation.
290	Definition good at times.
291 292 293	Considered good, but seen mostly through thin cloud.
294 295 296	Good observation.
297 298 299	Definition variable; internal contact good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power used.
	1886.				h m s	h m s	h m s	m s	
300	May 7	C	I. Sh. I.	First seen	6 14 2·1	20 59 41·8	—	—	125
301				Internal contact	6 16 29·1	21 2 8·8	—	—	"
302	"	S	I. Tr. E.	Internal contact	7 27 7·0	22 12 46·7	—	—	200
303				About bisected	7 29 12·0	22 14 51·7	—	—	"
304				External contact	7 31 32·0	22 17 11·7	—	—	"
305	May 13	S	I. Oc. D.	External contact	9 45 4·6	0 30 44·3	—	—	125
306				Still visible	9 48 4·6	0 33 44·3	—	—	"
307				Disappearance	9 48 29·6	0 34 9·3	—	—	"
308	May 14	S	III. Ec. R.	First seen	5 51 40·0	20 37 19·7	20 37 39	+ 0 19	200
309				Quite distinct	5 51 41·0	20 37 20·7	—	—	"
310				Full blaze	5 58 22·0	20 44 1·7	—	—	"
311	"	S	I. Tr. I.	External contact	7 3 36·9	21 49 16·6	—	—	"
312				About bisected	7 5 46·9	21 51 26·6	—	—	"
313				Internal contact	7 7 51·9	21 53 31·6	—	—	"
314	"	C	I. Sh. I.	First seen	8 8 1·8	22 53 41·5	—	—	"
315				Internal contact	8 9 56·8	22 55 36·5	—	—	"
316	"	C	I. Tr. E.	Internal contact	9 16 41·6	0 2 21·3	—	—	"
317				About bisected	9 18 26·6	0 4 6·3	—	—	"
318				External contact	9 20 25·6	0 6 5·3	—	—	"
319	May 15	S	II. Oc. D.	External contact	8 40 54·4	23 26 34·1	—	—	"
320				Still visible	8 42 59·4	23 28 39·1	—	—	"
321				Disappearance	8 43 19·4	23 28 59·1	—	—	"
322	May 28	S	III. Oc. D.	External contact	6 8 49·4	20 54 29·1	—	—	"
323				Still visible	6 16 3·4	21 1 43·1	—	—	"
324				Disappearance	6 16 9·4	21 1 49·1	—	—	"
325	May 29	S	I. Oc. D.	External contact	7 54 22·3	22 40 2·0	—	—	"
326				Still visible	7 57 2·3	22 42 42·0	—	—	"
327				Just glimpsed	7 57 5·3	22 42 45·0	—	—	"
328				Disappearance	7 57 12·3	22 42 52·0	—	—	"
329	June 4	S	III. Oc. D.	External contact	9 56 33·8	0 42 13·5	—	—	125
330				Still visible	10 2 38·8	0 48 18·5	—	—	"
331				Disappearance	10 2 58·8	0 48 38·5	—	—	"
332	June 14	S	I. Oc. D.	External contact	6 8 31·2	20 54 10·9	—	—	200
333				Still visible	6 11 11·2	20 56 50·9	—	—	"
334				Disappearance	6 11 22·2	20 57 1·9	—	—	"
335	"	T	I. Ec. R.	First seen	9 37 45·0	0 23 24·7	0 23 35	+ 0 10	200
336	June 15	C	III. Sh. I.	First seen	8 57 39·7	23 43 19·4	—	—	125
337				Internal contact	9 4 53·7	23 50 33·4	—	—	"

338	June 16	S	II. Oc. D.	External contact	8 2 11·0	22 47 50·7	—	—	200
339				Still visible	8 5 55·0	22 51 34·7	—	—	"
340				Disappearance	8 6 5·0	22 51 44·7	—	—	"
341	June 28	S	IV. Tr. E.	Clear of limb	5 23 45·0	20 9 24·7	—	—	"
342	June 30	C	I. Ec. R.	First seen	7 56 11·9	22 41 51·6	22 41 59	+ 0 7	125
343				Quite distinct	7 56 17·4	22 41 57·1	—	—	"
344				Full blaze	7 59 42·4	22 45 22·1	—	—	"
345	July 22	S	I. Tr. I.	External contact	7 41 53·1	22 27 32·8	—	—	200
346				About bisected	7 43 44·1	22 29 23·8	—	—	"
347				Internal contact	7 46 29·1	22 32 8·8	—	—	"

REMARKS.

Ref. No.	
300, 301	Considered good.
302, 303, 304	Observation considered good, although limb was rather unsteady.
305, 306, 307	Through cloud. Definition very good, but the cloud prevented a higher power than 125 being used. The satellite appeared very small and faint, but the external contact is considered fair. The time of disappearance is only approximate, as the cloud became dense just before time noted, and at 9h. 48m. 29·6s., when the cloud had cleared. the satellite could not be seen.
308, 309, 310	Definition very good.
311, 312, 313	Definition very good.
315	Considered very good.
316, 317, 318	Good.
319, 320, 321	Definition bad.
322, 323, 324	Definition generally good, but limb beginning to boil a little at disappearance. Thin clouds constantly passing over.
325, 326, 327, 328	Observation very good.
329, 330, 331	Definition bad, and observation not reliable ; limb boiling.
332, 333, 334	Definition good ; satellite appeared very small indeed.
335	Definition bad.
336, 337	Definition variable ; observation considered good.
338, 339, 340	Definition not good ; limb woolly and unsteady.
341	Clouds prevented observation being taken, but they cleared for a few moments directly after computed time of egress, and the satellite was just a little off the limb at 5h. 23m. 45s., A.M.T. The satellite was extremely faint, appearing of a dusky, brownish-yellow color, much fainter than any of the others, and I doubt whether it would have been visible on the disc near the limb.
342, 343, 344	Definition variable ; observation considered good.
345, 346, 347	Good observation, but limb a little unsteady at times.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ **LATITUDE, 34° 55′ 38·5″ S.**

1878.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	March 2	S	I. Tr. E.	Internal contact	11 33 12·8	2 18 52·5	—	—	200
2				About bisected	11 35 22·8	2 21 2·5	—	—	"
3				External contact	11 37 57·8	2 23 37·5	—	—	"
4	March 10	C	I. Oc. R.	First seen	10 43 51·5	1 29 31·2	—	—	125
5				External contact	10 46 39·5	1 32 19·2	—	—	"
6	March 31	C	II. Oc. R.	First seen	10 20 12·9	1 5 52·6	—	—	"
7				Quite distinct	10 20 52·9	1 6 32·6	—	—	"
8				External contact	10 24 56·9	1 10 36·6	—	—	"
9	April 7	S	II. Ec. D.	Still visible	9 27 25·5	0 13 5·2	—	—	200
10				Disappearance	9 27 28·5	0 13 8·2	0 12 32	— 0 36	"
11	April 16	S	II. Sh. E.	Internal contact	9 29 28·4	0 15 8·1	—	—	"
12				Still visible	9 32 2·4	0 17 42·1	—	—	"
13				Suspected glimpse	9 32 23·4	0 18 3·1	—	—	"
14				Limb complete	9 32 43·4	0 18 23·1	—	—	"
15	"	S	II. Tr. E.	Internal contact	9 39 45·4	0 25 25·1	—	—	"
16				About bisected	9 41 53·4	0 27 33·1	—	—	"
17				External contact	9 45 43·4	0 31 23·1	—	—	"
18	"	S	I. Ec. D.	Just visible	11 39 22·5	2 25 2·2	—	—	"
19	"			Disappearance	11 39 24·5	2 25 4·2	2 24 10	— 0 54	"

20	April 18.............	C	I. Oc. R.	First seen	8 18 16·9	23 3 56·6	—	—	125
21				External contact	8 21 59·9	23 7 39·6	—	—	“
22	April 23.............	S	II. Tr. I.	External contact	9 25 21·4	0 11 1·1	—	—	200
23				About bisected	9 27 55·4	0 13 35·1	—	—	“
24				Internal contact	9 30 51·4	0 16 31·1	—	—	“
25	“	S	II. Tr. E.	Internal contact	11 52 51·4	2 38 31·1	—	—	125
26				About bisected	11 55 52·4	2 41 32·1	—	—	“
27				External contact	11 58 11·4	2 43 51·1	—	—	“
28	April 24.............	C	I. Tr. I.	External contact	10 34 52·8	1 20 32·5	—	—	200
29				About bisected	10 36 59·8	1 22 39·5	—	—	“
30				Internal contact	10 39 16·8	1 24 56·5	—	—	“
31	“	C	I. Sh. I.	First seen	10 39 16·8	1 24 56·5	—	—	“
32				Internal contact	10 43 25·8	1·29 5·5	—	—	“

REMARKS.

Ref. No.	
1, 2, 3	Definition very variable, mostly very bad; at the times of the different phases, however, it was fair indeed, and the observation may be considered good.
4, 5	Observation pretty good; definition variable.
6, 7, 8	Definition variable; observation pretty good. This phenomenon was also observed by S. with an 8½in. reflector, power 120, who gives “First seen” 10h. 20m. 24·0s., “external contact” 10h. 24m. 21·0s., A.M.T.; definition fair.
9, 10	Definition very bad at disappearance.
11, 12, 12, 13, 14	Internal contact good, but disappearance very uncertain, the limb being unsteady at the time. Last time *certainly* seen was that noted as “still visible.”
15, 16, 17	Fair.
18, 19	Good observation.
20, 21	Definition variable, but observation considered good. At time noted as “First seen” I saw the satellite as a tiny bright speck apparently *inside* Jupiter's following limb.
22, 23, 24	Definition bad; limb woolly.
25, 26	Definition bad.
27	Definition moderately fair.
28, 29, 30	Definition very good
31, 32	Definition very good. Satellite just touching shadow.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
33	April 30............	S	III. Ec. R.	First seen	7 47 8·9	22 32 48 6	22 35 26	+ 2 37	125
34				Quite distinct	7 47 11·9	22 32 51 6	—	—	"
35	May 16............	S	II. Oc. D.	External contact	10 33 15·4	1 18 55·1	—	—	200
36				Still visible	10 36 35·4	1 22 15·1	—	—	"
37				Limb complete	10 36 40·4	1 22 20·1	—	—	"
38	May 18............	S	II. Tr. E.	Internal contact	7 46 40·4	22 32 20·1	—	—	125
39				About bisected	7 49 14·4	22 34 54·1	—	—	"
40				External contact	7 51 35·4	22 37 15·1	—	—	"
41	"	C	I. Ec. R.	First seen	10 18 19·2	1 3 58·9	1 4 20	+ 0 21	"
42				Quite distinct	10 18 20·4	1 4 0·1	—	—	"
43	June 27............	S	I. Sh. E.	Internal contact	6 1 34·7	20 47 14·4	—	—	200
44				Limb still indented	6 4 34·7	20 50 14·4	—	—	"
45				Limb complete	6 4 44·7	20 50 24·4	—	—	"
46	July 12............	S	II. Oc. D.	External contact	6 4 52·5	20 50 32·2	—	—	"
47				Still visible	6 8 25·5	20 54 5·2	—	—	"
48				Limb complete	6 8 39·5	20 54 19·2	—	—	"
49	"	S	I. Ec. R.	First seen	7 5 3·5	21 50 43·2	21 51 17	+ 0 34	"
50				Plainly visible	7 5 5·5	21 50 45·2	—	—	"
51	"	S	II. Ec. R.	First seen	11 15 32·5	2 1 12·2	2 0 50	— 0 22	125
52				Plainly visible	11 15 35·5	2 1 15·2	—	—	"
53	July 19............	C	I. Ec. R.	First seen	9 0 8·3	23 45 48·0	23 45 58	+ 0 10	"

54	July 21.............	C	II. Tr. E.	Internal contact	5 39 54·6	20 25 34·3	—	—	125
55				About bisected	5 42 24·6	20 28 4·3	—	—	"
56				External contact	5 45 19·6	20 30 59·3	—	—	"
57	"	C	II. Sh. I.	First seen	5 41 4·6	20 26 44·3	—	—	"
58				Internal contact	5 43 24·6	20 29 4·3	—	—	"
59	July 25.............	C	III. Ec. D.	Barely visible	5 59 35·6	20 45 15·3	—	—	"
60				Disappeared	5 59 48·1	20 45 27·8	20 37 57	– 7 31	"
61	"	C	III. Ec. R.	First seen	7 25 25·6	22 11 5·3	22 13 51	+ 2 46	"
62	August 2	S	I. Oc. D.	External contact	9 22 9·4	0 7 49·1	—	—	"
63				Still visible	9 25 44·4	0 11 24·1	—	—	"

REMARKS.

Ref. No.	
33 34	Definition very bad.
35 36 37	Fair.
38 39 40	Observation considered fair.
41 42	Considered good.
43 44 45	Partly through cloud; definition very fair.
46 47 48	Definition good.

Ref. No.	
51 52	Planet low down.
53	Thin clouds came over just at the time of reappearance, but I think the observation is pretty good.
54 55 56	Definition good.
57 58	Definition good.
59 60	Very good.
61	Definition good.
62 63	Definition so bad it was impossible to get disappearance.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, Soutn Australia.

Longitude, 9h. 14m. 20·3s. E. ‖ **Latitude**, 34° 56′ 38·5″ S.

1888.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	April 4............	S	I. Ec. D.	Still visible	10 46 10·8	1 31 50·5	—	—	120
2				Disappeared	10 46 12·8	1 31 52·5	1 30 51	– 1 1	"
3	April 5............	S	I. Tr. E.	Internal contact	10 55 54·3	1 41 34·0	—	—	200
4				Bisected	10 58 4·3	1 43 44·0	—	—	"
5				External contact	11 0 39·3	1 46 19·0	—	—	"
6	April 7............	S	II. Ec. D.	Still visible	10 39 37·0	1 25 16·7	—	—	125
7				Disappeared	10 39 38·0	1 25 17·7	1 25 34	+ 0 16	"
8	April 20............	C	I. Ec. D.	Still visible	9 1 27·0	23 47 6·7	—	—	"
9				Just glimpsed	9 1 35·0	23 47 14·7	23 46 27	– 0 48	"
10	April 28............	S	I. Tr. I.	External contact	8 32 36·0	23 18 15·7	—	—	"
11				Bisected	8 34 46·0	23 20 25·7	—	—	"
12				Internal contact	8 37 16·0	23 22 55·7	—	—	"
13	"	S	I. Sh. E.	Internal contact	10 9 16·0	0 54 55·7	—	—	"
14	"	S	I. Tr. E.	External contact	10 44 16·0	1 29 55·7	—	—	"
15	May 9	C	II. Ec. D.	Still visible	10 14 55·4	1 0 35·1	—	—	"
16				Disappeared	10 14 56·9	1 0 36·6	1 0 50	+ 0 13	"
17	May 21............	C	I. Tr. I.	External contact	8 9 41·7	22 55 21·4	—	—	200
18				Bisected	8 11 46·7	22 57 26·4	—	—	"
19				Internal contact	8 14 11·7	22 59 51·4	—	—	"
20	"	C	I. Tr. E.	Internal contact	10 19 26·9	1 5 6·6	—	—	"
21				Bisected	10 21 28·9	1 7 8·6	—	—	"
22				External contact	10 23 41·9	1 9 21·6	—	—	"
23	May 22............	C	I. Oc. R.	First seen	7 41 22·6	22 27 2·3	—	—	125
24				External contact	7 44 3·6	22 29 43·3	—	—	"

25	May 28............	C	III. Oc. D.	External contact	7 56 56·3	22 42 36·0	—	—	200
26				Bisected	8 3 26·3	22 49 6·0	—	—	"
27				Internal contact	8 9 56·3	22 55 36·0	—	—	"
28				Disappeared	8 14 9·3	22 59 49·0	—	—	"
29	"	C	I. Tr. I.	External contact	9 53 41·5	0 39 21·2	—	—	"
30				Bisected	9 55 56·5	0 41 36·2	—	—	"
31				Internal contact	9 58 20·5	0 44 0·2	—	—	"
32	"	C	I. Sh. I.	First seen	10 4 39·5	0 50 19·2	—	—	"
33				Internal contact	10 7 22·5	0 53 2·2	—	—	"
34	"	C	III. Ec. R.	Quite distinct	10 12 16·5	0 57 56·2	1 1 24	+ 3 28	"
35	June 6............	S	I. Tr. I.	External contact	6 4 26·7	20 50 6·4	—	—	125
36				Bisected	6 6 41·7	20 52 21·4	—	—	"
37				Internal contact	6 9 46·7	20 55 26·4	—	—	"
38	June 13............	S	I. Tr. I.	Internal contact	7 55 34·1	22 41 13·8	—	—	200

REMARKS.

Ref. No.	
1 2	Taken with 8½in. reflector.
3 4 5	Definition variable; external contact good.
6 7	Definition bad; very bad at times.
8 9	Definition very variable.
10 11 12	Definition very variable; fair at times.
13	Definition fair.
14	Considered fair.
15 16	Considered good.
17 18 19	Definition variable, but generally good; internal contact very good.
20 21 22	Good; very good at times.

Ref. No.	
23 24	Pretty good; seen through thin cirro-stratus.
25 26 27 28	Definition good: at times very good. The satellite disappeared behind Jupiter in very high S. latitude, and consequently the external contact was difficult to estimate correctly. With regard to internal contact, it seemed to me that at 8h. 9m. 56·3s. A.M.T. the limbs of the satellite and planet were tangential, but after that time a portion of the satellite remained distinctly visible as a minute speck *inside* Jupiter's limb until the time noted as "disappeared." —C.
29 30 31	Definition generally good.
32 33	Definition good; very good at times.
34	Definition good; first emergence lost, probably about ½ minute to 1 minute before the time noted.
35 36 37	Definition generally bad, but fair at times.
38	Clouds about.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
39	June 22	C	I. Tr. E.	Internal contact	6 12 30·3	20 58 10·0	—	—	200
40				Bisected	6 14 32·3	21 0 12·0	—	—	"
41				External contact	6 16 15·3	21 1 55·0	—	—	"
42	"	C	I. Sh. E.	Internal contact	6 54 40·3	21 40 20·0	—	—	"
43				Limb nearly complete	6 57 5·3	21 42 45·0	—	—	"
44	June 26	S	II. Tr. I.	External contact	8 30 28·3	23 16 8·0	—	—	"
45				Bisected	8 32 38·3	23 18 18·0	—	—	"
46				Internal contact	8 35 3·3	23 20 43·0	—	—	"
47	June 29	C	I. Tr. I.	Internal contact	5 49 49·4	20 35 29·1	—	—	"
48				Bisected	5 51 59·6	20 37 39·3	—	—	"
49				External contact	5 54 15·5	20 39 55·2	—	—	"
50	"	C	I. Tr. E.	Internal contact	7 58 52·9	22 44 32·6	—	—	"
51				Bisected	8 0 45·9	22 46 25·6	—	—	"
52				External contact	8 2 52·9	22 48 32·6	—	—	"
53	July 3	S	III. Ec. R.	First seen	6 7 34·0	20 53 13·7	20 58 2	+ 4 48	"
54				Quite distinct	6 7 37·0	20 53 16·7	—	—	"
55	July 6	C	I. Tr. E.	Internal contact	9 46 40·0	0 32 19·7	—	—	"
56				Bisected	9 48 52·0	0 34 31·7	—	—	"
57				External contact	9 51 2·0	0 36 41·7	—	—	"
58	July 30	C	II. Ec. R.	First seen	6 42 15·0	21 27 54·7	21 27 18	— 0 37	"
59				Quite distinct	6 42 19·7	21 27 59·4	—	—	"
60	"	C	I. Ec. R.	First seen	8 16 14·5	23 1 54·2	23 2 24	+ 0 30	"
61				Quite distinct	8 16 19·8	23 1 59·5	—	—	"
62	August 4	S	II. Tr. I.	External contact	9 46 0·0	0 31 39·7	—	—	"
63				Bisected	9 48 10·0	0 33 49·7	—	—	"
64				Internal contact	9 51 45·0	0 37 24·7	—	—	"
65	August 7	S	I. Tr. E.	External contact	6 11 20·5	20 57 0·2	—	—	"

66	August 15...........	S	III. Ec. R.	First seen	6 8 2·2	20 53 41·9	20 57 16	+ 3 34	200
67				Quite distinct	6 8 5·2	20 53 44·9	—	—	“
68	“	C	I. Ec. R.	First seen	6 35 40·8	21 21 20·5	21 20 37	– 0 43	“
69				Quite distinct	6 35 43·3	21 21 23·0	—	—	“
70	August 22...........	S	II. Tr. E.	Internal contact	6 36 51·6	21 22 31·3	—	—	“
71				Bisected	6 39 28·6	21 25 8·3	—	—	“
72				External contact	6 41 45·6	21 27 25·3	—	—	“
73	“	S	III. Ec. D.	Still visible	8 22 36·8	23 8 16·5	—	—	“
74				Disappeared	8 22 39·8	23 8 19·5	23 3 47	– 4 32	“
75	“	C	III. Ec. R.	First seen	10 7 33·0	0 53 12·7	—	—	125
76				Quite distinct	10 7 48·0	0 53 27·7	0 56 56	+ 3 28	“
77	September 13	S	I. Tr. I.	External contact	8 6 45·9	22 52 25·6	—	—	200
78				Bisected	8 9 23·9	22 55 3·6	—	—	“
79				Internal contact	8 11 56·9	22 57 36·6	—	—	“

REMARKS.

Ref. No.	
39 40 41	Definition pretty good.
42 43	Definition pretty good, but clouds prevented getting satisfactory observation of “limb complete”; this, however, occurred about 6h. 57m. 35s A.M.T.
44 45 46	Well defined.
47 48 49	Good.
50 51 52	Definition variable; observation considered good.
55 56 57	Definition of limb good.

Ref. No.	
58 59	Definition good.
60 61	Considered very good.
62 63 64	Limb of planet unsteady; definition bad at times.
65	Good.
68 69	Pretty good.
70 71 72	Definition good.
75 76	Definition very variable; observation considered good.
77 78 79	Definition fair.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 56′ 38·5″ S.

1889.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	May 14............	S	III. Ec. D.	Barely visible	11 15 51·9	2 1 31·6	—	—	200
2				Disappeared	11 15 52·9	2 1 32·6	1 58 47	— 2 46	“
3	May 16............	S	I. Ec. D.	Barely visible	12 9 3·6	2 54 43·3	—	—	“
4				Disappeared	12 9 4·6	2 54 44·3	2 53 54	— 0 50	“
5	June 25............	—	I. Tr. E.	Internal contact	9 52 43·7	0 38 23·4	—	—	“
6				Bisected	9 54 55·7	0 40 35·4	—	—	“
7				External contact	9 57 36·7	0.43 16·4	—	—	“
8	June 26............	S	III. Oc. D.	External contact	10 44 25·7	1 30 5·4	—	—	“
9				Bisected	10 49 5·7	1 34 45·4	—	—	“
10				Still visible	10 54 14·7	1 39 54·4	—	—	“
11				Limb complete	10 54 20·7	1 40 0·4	—	—	“
12	July 3............	S	I. Ec. R.	First seen	9 11 8·1	23 56 47·8	23 56 50	+ 0 2	“
13				Quite distinct	9 11 9·1	23 56 48·8	—	—	“
14	July 9............	S	I. Tr. I.	External contact	11 8 29·9	1 54 9·6	—	—	300
15				Bisected	11 10 39·9	1 56 19·6	—	—	“
16				Internal contact	11 12 44·9	1 58 24·6	—	—	“
17	July 10............	C	I. Oc. D.	External contact	8 26 14·3	23 11 54·0	—	—	200
18				Bisected	8 27 57·4	23 13 37·1	—	—	“
19				Internal contact	8 30 41·5	23 16 21·2	—	—	“
20				Disappeared	8 31 28·1	23 17 7·8	—	—	“

21	July 10.............	S	I. Ec. R.	First seen	11 5 41·1	1 51 20·8	1 51 25	+ 0 4	200
22				Quite distinct	11 5 42·1	1 51 21·8	—	—	"
23	July 16.............	S	IV. Oc. D.	—	—	—	—	—	"
24	"	S	IV. Oc. R.	External contact	8 23 59·4	23 9 39·1	—	—	"
25	"	S	IV. Ec. D.	Last seen	12 16 43·5	3 2 23·2	2 39 12	—23 11	125
26	July 17.............	S	I. Oc. D.	External contact	10 12 49·8	0 58 29·5	—	—	200
27				Bisected	10 14 39·8	1 0 19·5	—	—	"
28				Still visible	10 15 52·8	1 1 32·5	—	—	"
29				Limb complete	10 15 54·8	1 1 34·5	—	—	"
30	July 18.............	S	I. Tr. I.	External contact	7 18 59·1	22 4 38·8	—	—	"
31				Bisected	7 21 19·1	22 6 58·8	—	—	"
32				Internal contact	7 23 29·1	22 9 8·8	—	—	"

REMARKS.

Ref. No.	
1 2	Definition very good.
3 4	Very thin cirro-stratus which would make very little difference; definition good.
5 6 7	Definition good but variable.
8 9 10 11	Definition good.
14 15 16	Through cloud; definition very good. Satellite apparently very small.
17 18 19 20	Definition variable, very good at times. Both Mr. Sells and myself noticed that at "bisection" the phenomenon strongly resembled a Tr. I. I could certainly see a faint point of light *inside* the limb after "internal contact" which separated a short distance from the limb, and growing gradually smaller disappeared finally at 8h. 31m. 28·1s. A.M.T.—C.

Ref. No.	
23 24	There was no complete occultation though it was extremely hard to make out the satellite when passing the pole of the planet, all but a tiny point being occulted. The greatest amount of occultation was judged to take place at 7h. 46m. A.M.T., when the slightest tremor of Jupiter's limb prevented the satellite from being seen, and even when the definition was at its best the satellite was only made out with the greatest difficulty.—S.
26 27 28 29	Definition not good; satellite appeared very small.
30 31 32	Good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
33	July 18.............	S	I. Tr. E.	Internal contact	9 33 9·6	0 18 49·3	—	—	200
34				Bisected	9 35 4·6	0 20 44·3	—	—	"
35				External contact	9 37 19·6	0 22 59·3	—	—	"
36	July 19.............	S	I. Ec. R.	First seen	7 28 56·0	22 14 35·7	22 14 47	+ 0 11	"
37				Quite distinct	7 28 57·0	22 14 36·7	—	—	"
38				Still visible	7 0 49·1	21 46 28·8	—	—	"
39	August 1............	S	III. Ec. D.	Disappeared	7 0 51·1	21 46 30·8	21 45 4	– 1 27	"
40	August 2............	S	IV. Ec. D.	Last seen	6 0 16·8	20 45 56·5	20 34 32	–11 24	125
41	September 2........	S	III. Tr. 1.	External contact	7 41 22·4	22 27 2·1	—	—	200
42				Bisected	7 45 28·4	22 31 8·1	—	—	"
43				Internal contact	7 51 32·4	22 37 12·1	—	—	"
44	"	S	I. Tr. E.	External contact	9 25 37·7	0 11 17·4	—	—	125
45	September 13........	S	III. Ec. R.	First seen	9 51 38·4	0 37 18·1	—	—	200
46				Quite distinct	9 51 45·9	0 37 25·6	0 40 28	+ 3 2	"
47	September 21........	S	IV. Ec. D.	Last seen	11 48 4·2	2 33 43·9	2 29 34	– 4 10	"
48	September 24........	S	II. Tr. E.	External contact	8 3 40·9	22 48 20·6	—	—	"
49	October 17..........	S	II. Oc. D.	External contact	7 44 38·6	22 30 18·3	—	—	"
50				Bisected	7 47 16·6	22 32 56·3	—	—	"
51				Internal contact	7 49 34·6	22 35 14·3	—	—	"

52	October 18..........	S	I. Tr. I.	External contact	7 39 34·8	22 25 14·5	—	—	200
53				Bisected	7 42 24·8	22 28 4·5	—	—	
54				Internal contact	7 45 18·8	22 30 58·5	—	—	“
55	November 18........	S	I. Oc. D.	External contact	7 23 45·4	22 9 25·1	—	—	“
57				Bisected	7 25 50·4	22 11 30·1	—	—	“
57				Still visible	7 27 15·4	22 12 55·1	—	—	“
58				Disappeared	7 27 25·4	22 13 5·1	—	—	“

REMARKS.

Ref. No.	
40	Definition bad.
43	Thin cloud about.
44	Definition bad. Internal contact and bisection not obtainable on account of the bad definition. No belts visible on planet at times, definition so bad.
45 46	Satellite suspected at 38·4s., then lost; but glimpsed again at 38·9s., lost again until about 41·0s., and seen plainly but very faint at 45·9s. Cloud came over the planet about half a minute later.
47	Definition very bad indeed.
48	Definition bad. Satellite not visible till partly off disc owing to bad definition. Bisection not obtainable.
49 50 51	Definition bad.
52 53 54	Clouds passing over at external contact. Definition very variable, but good at bisection and internal contact.
55 56 57 58	Definition fair, 58 not considered very reliable.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 56′ 38·5″ S.

1891.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	August 11...........	S	I. Tr. E.	Internal contact	10 8 17·3	0 53 57·0	—	—	160
2				About bisected	10 10 47·3	0 56 27·0	—	—	"
3				External contact	10 13 42·3	0 59 22·0	—	—	"
4	August 26...........	S	I. Oc. R.	External contact	10 56 30·6	1 42 10·3	—	—	"
5	"	S	IV. Oc. R.	External contact	11 5 50·6	1 51 30·3	—	—	"
6	August 27...........	S	II. Oc. R.	First seen	9 53 26·5	0 39 6·2	—	—	"
7	September 10........	S	I. Tr. I.	External contact	9 13 41·5	23 59 21·2	—	—	"
8				About bisected	9 16 21·5	0 2 1·2	—		
9				Internal contact	9 18 21·5	0 4 1·2	—	—	"
10	"	S	I. Tr. E.	Slightly off limb	11 29 41·4	2 15 21·1	—	—	"
11				About bisected	11 31 14·4	2 16 54·1	—	—	"
12				External contact	11 33 35·4	2 19 15·1	—	—	"
13	"	S	II. Oc. D.	External contact	11 31 46·4	2 17 26·1	—	—	"
14				Limb complete	11 35 27·4	2 21 7·1	—	—	"
15	"	S	I. Sh. E.	Internal contact	11 36 56·4	2 22 36·1	—	—	"
16				Still visible	11 39 39·4	2 25 19·1	—	—	"
17				Limb complete	11 39 46·4	2 25 26·1	—	—	"
18	September 20........	T	IV. Tr. I	External contact	6 11 47·0	20 57 26·7	—	—	"
19				About bisected	6 15 42·0	21 1 21·7	—	—	"
20				Very fine nipple	6 17 39·0	21 3 18·7	—	—	"
21				Internal contact	6 19 8·5	21 4 48·2	—	—	"
22	"	S	IV. Tr. E.	—	—	—	—		"

23	September 21........	S	III. Oc. D.	External contact	9 35 16·2	0 20 55·9	—	—	160
24				About bisected	9 38 51·2	0 24 30·9	—	—	"
25				Still visible	9 43 6·2	0 28 45·9	—	—	"
26				Disappeared	9 43 11·2	0 28 50·9	—	—	"
27	September 26........	S	I. Tr. I.	About bisected	7 11 11·4	21 56 51·1	—	—	"
28				Internal contact	7 13 26·4	21 59 6·1	—	—	"
29	"	S	I. Tr. E.	External contact	9 27 41·3	0 13 21·0	—	—	"
30	October 5..........	S	II. Oc. D.	External contact	7 23 33·7	22 9 13·4	—	—	"
31				About bisected	7 25 53·7	22 11 33·4	—	—	"
32				Still visible	7 27 0·7	22 12 40·4	—	—	"
33				Suspected visible	7 27 18·7	22 12 58·4	—	—	"
34	October 15..........	S	IV. Oc. R.	External contact	6 36 59·4	21 22 39·1	—	—	"
35	October 18..........	S	I. Oc. D.	External contact	9 45 5·3	0 30 45·0	—	—	"

REMARKS.

Ref. No.	
1 2 3	Definition variable; fair at times; observation considered good.
4	Observation perhaps a little late; first instant of reappearance lost through cloud.
5	Observation uncertain on account of cloud and dimness of satellite, which appeared very small, much smaller than I. The latter having reappeared from occultation only ten minutes previously the two satellites appeared not far apart from each other, rendering comparison easy.
6	External contact lost through cloud.
7 8 9	Definition good, but clouds very troublesome.
10 11 12	Definition good.
18 19 20 21	Definition not good, but observation considered good. At 6h. 20m. 22·0s. A.M.T. the satellite could only be glimpsed occasionally; at 6h. 23m. 47·0s. the satellite was invisible; and at 6h. 34m. 32·0s. it appeared as a black spot. At mid-transit the satellite was observed by S. to be perfectly black, just like a shadow.
22	IV. Tr. E. was lost through cloud, but it was noticed that when getting near the planet's limb the satellite lost a great deal of its blackness, appearing grey rather than black, and was becoming faint by the time clouds came up and put a stop to observation.
23 24 25 26	Definition good; External contact through cloud.
27 28	External contact lost through cloud. Definition good, but planet seen through cloud. Internal contact considered good.
29	Definition of limb very fair; observation considered good.
30 31 32 33	Definition not good. Disappearance could not be obtained owing to the woolliness of Jupiter's limb. It was thought that at 7h. 27m. 18·7s. A.M.T. the satellite was momentarily glimpsed as a tiny nipple projecting from the planet's limb, but the glimpse was a fleeting one only, and may have been an effect of fancy.
34	Seen through thin cloud. Satellite very faint and dim and of a greyish color, though on the cloud clearing off just after external contact, the satellite regained its usual yellowish tint, and seemed to increase in brightness to a much greater degree than the other satellites or Jupiter itself. When in contact with the planet the satellite appeared of a much duller shade than the planet's polar shading; this was very noticeable.
35	Disappearance lost owing to limb of planet becoming blurred and indistinct just then. External contact considered very good. No trace of the satellite could be seen through the limb; on the contrary, at moments of clearest vision, when the definition was very good indeed, the satellite appeared sharply cut off by limb of planet.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 56′ 38·5″ S.

1891.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	August 11...........	S	I. Tr. E.	Internal contact	10 8 17·3	0 53 57·0	—	—	160
2				About bisected	10 10 47·3	0 56 27·0	—	—	“
3				External contact	10 13 42·3	0 59 22·0	—	—	“
4	August 26...........	S	I. Oc. R.	External contact	10 56 30·6	1 42 10·3	—	—	“
5	“	S	IV. Oc. R.	External contact	11 5 50·6	1 51 30·3	—	—	“
6	August 27...........	S	II. Oc. R.	First seen	9 53 26·5	0 39 6·2	—	—	“
7	September 10........	S	I. Tr. I.	External contact	9 13 41·5	23 59 21·2	—	—	“
8				About bisected	9 16 21·5	0 2 1·2	—		
9				Internal contact	9 18 21·5	0 4 1·2	—	—	“
10	“	S	I. Tr. E.	Slightly off limb	11 29 41·4	2 15 21·1	—	—	“
11				About bisected	11 31 14·4	2 16 54·1	—	—	“
12				External contact	11 33 35·4	2 19 15·1	—	—	“
13	“	S	II. Oc. D.	External contact	11 31 46·4	2 17 26·1	—	—	“
14				Limb complete	11 35 27·4	2 21 7·1	—	—	“
15	“	S	I. Sh. E.	Internal contact	11 36 56·4	2 22 36·1	—	—	“
16				Still visible	11 39 39·4	2 25 19·1	—	—	“
17				Limb complete	11 39 46·4	2 25 26·1	—	—	“
18	September 20........	T	IV. Tr. I	External contact	6 11 47·0	20 57 26·7	—	—	“
19				About bisected	6 15 42·0	21 1 21·7	—	—	“
20				Very fine nipple	6 17 39·0	21 3 18·7	—	—	“
21				Internal contact	6 19 8·5	21 4 48·2	—	—	“
22	“	S	IV. Tr. E.	—	—	—	—		“

23	September 21........	S	III. Oc. D.	External contact	9 35 16·2	0 20 55·9	—	—	160
24				About bisected	9 38 51·2	0 24 30·9	—	—	"
25				Still visible	9 43 6·2	0 28 45·9	—	—	"
26				Disappeared	9 43 11·2	0 28 50·9	—	—	"
27	September 26........	S	I. Tr. I.	About bisected	7 11 11·4	21 56 51·1	—	—	"
28				Internal contact	7 13 26·4	21 59 6·1	—	—	"
29	"	S	I. Tr. E.	External contact	9 27 41·3	0 13 21·0	—	—	"
30	October 5..........	S	II. Oc. D.	External contact	7 23 33·7	22 9 13·4	—	—	"
31				About bisected	7 25 53·7	22 11 33·4	—	—	"
32				Still visible	7 27 0·7	22 12 40·4	—	—	"
33				Suspected visible	7 27 18·7	22 12 58·4	—	—	"
34	October 15..........	S	IV. Oc. R.	External contact	6 36 59·4	21 22 39·1	—	—	"
35	October 18..........	S	I. Oc. D.	External contact	9 45 5·3	0 30 45·0	—	—	"

REMARKS.

Ref. No.	
1 2 3	Definition variable; fair at times; observation considered good.
4	Observation perhaps a little late; first instant of reappearance lost through cloud.
5	Observation uncertain on account of cloud and dimness of satellite, which appeared very small, much smaller than I. The latter having reappeared from occultation only ten minutes previously the two satellites appeared not far apart from each other, rendering comparison easy.
6	External contact lost through cloud.
7 8 9	Definition good, but clouds very troublesome.
10 11 12	Definition good.
18 19 20 21	Definition not good, but observation considered good. At 6h. 20m. 22·0s. A.M.T. the satellite could only be glimpsed occasionally; at 6h. 23m. 47·0s. the satellite was invisible; and at 6h. 34m. 32·0s. it appeared as a black spot. At mid-transit the satellite was observed by S. to be perfectly black, just like a shadow.
22	IV. Tr. E. was lost through cloud, but it was noticed that when getting near the planet's limb the satellite lost a great deal of its blackness, appearing grey rather than black, and was becoming faint by the time clouds came up and put a stop to observation.

Ref. No.	
23 24 25 26	Definition good; External contact through cloud.
27 28	External contact lost through cloud. Definition good, but planet seen through cloud. Internal contact considered good.
29	Definition of limb very fair; observation considered good.
30 31 32 33	Definition not good. Disappearance could not be obtained owing to the woolliness of Jupiter's limb. It was thought that at 7h. 27m. 18·7s. A.M.T. the satellite was momentarily glimpsed as a tiny nipple projecting from the planet's limb, but the glimpse was a fleeting one only, and may have been an effect of fancy.
34	Seen through thin cloud. Satellite very faint and dim and of a greyish color, though on the cloud clearing off just after external contact, the satellite regained its usual yellowish tint, and seemed to increase in brightness to a much greater degree than the other satellites or Jupiter itself. When in contact with the planet the satellite appeared of a much duller shade than the planet's polar shading; this was very noticeable.
35	Disappearance lost owing to limb of planet becoming blurred and indistinct just then. External contact considered very good. No trace of the satellite could be seen through the limb; on the contrary, at moments of clearest vision, when the definition was very good indeed, the satellite appeared sharply cut off by limb of planet.

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Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

Longitude, 9h. 14m. 20·3s. E. || **Latitude, 34° 56′ 38·5″ S.**

1892.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	October 14..........	G	II. Tr. I.	External contact	8 47 15·0	23 32 54·7	—	—	200
2				About bisected	8 48 45·0	23 34 24·7	—	—	"
3				Internal contact	8 51 0·0	23 36 39·7	—	—	"
4	"	G	I. Tr. I.	External contact	9 29 31·0	0 15 10·7	—	—	"
5				About bisected	9 31 25·0	0 17 4·7	—	—	"
6				Internal contact	9 33 45·0	0 19 24·7	—	—	"
7	October 23..........	G	III. Tr. E.	About bisected	8 2 2·6	22 47 42·3	—	—	"
8				External contact	8 8 47·6	22 54 27·3	—	—	"
9	"	G	I. Sh. E.	Internal contact	8 6 17·6	22 51 57·3	—	—	"
10				About bisected	8 7 32·6	22 53 12·3	—	—	"
11				External contact	8 8 17·6	22 53 57·3	—	—	"
12	"	G	III. Sh. E.	Internal contact	9 17 47·6	0 3 27·3	—	—	"
13				About bisected	9 23 2·6	0 8 42·3	—	—	"
14				External contact	9 26 47·6	0 12 27·3	—	—	"
15	November 7........	G	I. Ec. R.	First seen	9 13 11·8	23 58 51·5	23 58 58	+ 0 6	125
16				Full blaze	9 14 39·8	24 0 19·5	—	—	"
17	November 15........	T	II. Tr. E.	Internal contact	9 31 26·0	0 17 5·7	—	—	"
18				About bisected	9 33 6·0	0 18 45·7	—	—	"
19				External contact	9 36 18·0	0 21 57·7	—	—	"
20	November 17........	G	III. Ec. D.	Disappeared	9 15 32·0	0 0 15·0	23 59 32	— 0 43	"
21	November 21........	G	I. Oc. D.	External contact	9 53 8·8	0 38 48·5	—	—	200
22				About bisected	9 55 58·8	0 41 38·5	—	—	"
23				Disappeared	9 58 28·8	0 44 8·5	—	—	"

24	November 22........	G	I. Tr. E.	Quite clear	9 22 57·4	0 8 37·1	—	—	125
25	"	G	II. Tr. I.	External contact	9 24 27·4	0 10 7·1	—	—	"
26				About bisected	9 26 17·4	0 11 57·1	—	—	"
27				Very fine nipple	9 28 17·4	0 13 57·1	—	—	"
28	November 24........	G	III. Oc. D.	External contact	9 1 39·3	23 45 19·0	—	—	200
29				Very fine nipple	9 10 54·3	23 54 34·0	—	—	125
30				Limb complete	9 11 34·3	23 55 14·0	—	—	"
31	November 30........	G	I. Ec. R.	Reappearance	9 29 33·7	0 15 13·4	0 15 1	– 0 12	"
32	December 15........	G	I. Tr. E.	—	—	—	—	—	"
33	December 19........	S	III. Tr. I.	External contact	10 2 32·0	0 48 11·7	—	—	160
34				About bisected	10 8 1·0	0 53 40·7	—	—	"
35				Internal contact	10 15 44·0	1 1 23·7	—	—	"
36	December 31........	S	I. Tr. E.	External contact	7 34 17·3	22 19 57·0	—	—	200

REMARKS.

Ref. No.	
1 2 3	Definition bad.
4 5 6	Definition better, but variable. Internal contact pretty good.
7 8	Mere guess work; impossible to get internal contact, definition so bad; no detail visible on belts.
9 10 11	Definition bad.
12 13 14	Definition much better; good glimpses at times. "About bisected" considered a very fair observation.
15 16	Definition good. Through cirrus cloud; observation considered good.
17 18 19	Definition very bad. Satellite clinging to limb; observations of little or no value.
20	Definition good, but thin cirrus kept passing over.
21 22 23	Definition fair, but thin clouds passing over made limb of Jupiter very unsteady.
24	The sky was cloudy, but a glimpse of Jupiter was obtained at the time given, and the satellite was seen just clear of the limb.
25 26 27	Not good, owing to clouds which prevented internal contact from being obtained; observations not of much value.
28 29 30	Definition very bad indeed; observation of little good.
31	Definition very bad, and moon close to Jupiter; observation rather late, for when gilmpsed satellite was fairly bright.
32	Cloudy. A glimpse was obtained at 9h. 15m. 58s., A.M.T., when satellite was about half off the limb, and another glimpse at 9h. 19m. 23s., when the satellite was quite clear of the planet's limb.
33 34 35	Definition fair. The satellite being very far south from Jupiter's equator it was rather difficult to judge the exact moments when the contacts took place. The observation is considered fairly accurate.
36	Observation doubtful. Internal contact could not be obtained. The satellites could barely be seen, as only a quarter of an hour had elapsed since the sun set, and the planet was seen through cirrus cloud. The definition was bad, and this rendered it very difficult to judge when the satellite was really tangential to the planet's limb.

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LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 56′ 38·5″ S.

1893.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	January 2..........	S	II. Oc. R.	External contact	8 0 39·2	22 46 18·9	—	—	160
2	“ 2..........	S	II. Ec. D.	Still visible	8 12 53·2	22 58 32·9	—	—	“
3				Glimpsed	8 12 55·2	22 58 34·9	—	—	“
4				Disappeared	8 12 56·2	22 58 35·9	22 59 39	+ 1 3	“
5	January 7..........	S	I. Tr. I.	External contact	7 14 21·0	22 0 0·7	—	—	200
6				About bisected	7 16 3·0	22 1 42·7	—	—	“
7				Internal contact	7 19 16·0	22 4 55·7	—	—	“
8	January 9..........	S	II. Oc. D.	External contact	8 0 24·6	22 46 4·3	—	—	160
9				Still visible	8 4 33·6	22 50 13·3	—	—	“
10	January 27..........	S	II. Ec. R.	First glimpsed	7 45 27·6	22 31 7·3	—	—	200
11				**Plainly visible**	7 45 29·6	22 31 9·3	22 30 26	— 0 43	
12	January 30..........	S	I. Tr. I.	External contact	7 35 12·0	22 20 51·7	—	—	“
13				About bisected	7 37 48·0	22 23 27·7	—	—	“
14				Internal contact	7 40 51·0	22 26 30·7	—	—	“
15	February 4..........	S	III. Ec. R.	Suspected	7 26 26·0	22 12 5·7	—	—	125
16				Glimpsed	7 26 27·0	22 12 6·7	—	—	“
17				Plainly visible	7 26 40·0	22 12 19·7	22 16 31	+ 4 11	“
18	December 4........	T	I. Tr. E.	Internal contact	9 40 38·1	0 26 17·8	—	—	“
19				External contact	9 45 23·5	0 31 3·2	—	—	“
20	December 9........	T	III. Oc. D.	External contact	8 9 35·1	22 55 14·8	—	—	200
21				About bisected	8 14 40·1	23 0 19·8	—	—	“
22				Disappeared	8 24 13·1*a*	23 9 52·8	—	—	“
23				Gone	8 25 0·1*b*	23 10 39·8	—	—	“
24	“	T	III. Oc. R.	First seen	9 36 19·1	0 21 58·8	—	—	“
25				About bisected	9 42 1·1	0 27 40·8	—	—	“
26				External contact	9 48 0·6	0 33 40·3	—	—	“
27	“	S	III. Ec. D.	Still visible	10 29 47·1	1 15 26·8	—	—	“
28				Glimpsed	10 30 23·6	1 16 3·3	1 12 37	— 3 26	“

29	December 11........	T	II. Tr. E.	Internal contact	9 16 27·3	0 2 7·0	—	--	200
30				About bisected	9 18 21·6	0 4 1·3	—	—	"
31				External contact	9 22 16·6	0 7 56·3	—	—	"
32	"	T	I. Tr. I.	External contact	9 18 41·0	0 4 20·7	—	—	"
33				About bisected	9 20 40·7	0 6 20·4	—	—	"
34				Internal contact	9 22 47·3	0 8 27·0	—	—	"
35	December 12........	T	I. Ec. R.	First seen	9 16 38·7	0 2 18·4	0 2 44	+ 0 26	"
36				Full blaze	9 20 37·5	0 6 17·2	—	—	"
37	December 18........	T	II. Tr. I.	External contact	9 17 11·8	0 2 51·5	—	—	"
38				Internal contact	9 21 35·3	0 7 15·0	—	—	"
39	December 19........	T	I. Oc. D.	External contact	8 11 20·1	22 56 59·8	—	—	125
40				Visible through limb	8 15 52·6	23 1 32·3	—	—	"
41				Disappeared	8 16 44·6	23 2 24·3	—	—	"

REMARKS.

Ref. No.	
1	Definition very fair. but observation may be a trifle late.
2 3 4	Moon full, and twilight fairly strong.
5 6 7	Definition good: contact observations considered good. but bisection not good.
8 9	Cloud interfered with observation. External contact is considered fairly good, and at the time marked "still visible" the satellite itself could hardly be seen, but its presence was shown by the appearance of a small angular point on the planet's limb. At that moment definition became very unsteady, and by the time it had steadied again, or at 8h. 4m. 39·6s., A.M.T., no trace of the satellite could be seen.
10 11	Twilight strong.
12 13 14	Definition bad, but observation considered fair.
15 16 17	Very strong twilight. Second magnitude stars only glimpsed with difficulty with naked eye.
18 19	External contact considered good. but limb very unsteady.
20 21 22 23	Between *a* and *b* I caught sight of satellite again, but at *b* it had quite gone.
24 25 26	"First seen." Considered good.
27 28	At time given for "still visible," the definition suddenly became very bad and the satellite was immediately lost sight of. The image did not become fairly still again till 10h. 30m. 23 6s. A.M.T., when the satellite was just glimpsed for a moment and lost sight of again immediately, the definition again becoming very bad. The time given must be very close to the true time of disappearance; the satellite was such a minute speck.
29 30 31	External contact probably a little early.
32 33 34	Internal contact very good.
35 36	Outline of planet's shadow visible on satellite during emergence.
37 38	Definition variable.
39 40 41	Observation fair.

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Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	January 2..........	S	II. Oc. R.	External contact	8 0 39·2	22 46 18·9	—	—	160
2	“ 2..........	S	II. Ec. D.	Still visible	8 12 53·2	22 58 32·9	—	—	“
3				Glimpsed	8 12 55·2	22 58 34·9	—	—	“
4				Disappeared	8 12 56·2	22 58 35·9	22 59 39	+ 1 3	“
5	January 7..........	S	I. Tr. I.	External contact	7 14 21·0	22 0 0·7	—	—	200
6				About bisected	7 16 3·0	22 1 42·7	—	—	“
7				Internal contact	7 19 16·0	22 4 55·7	—	—	“
8	January 9..........	S	II. Oc. D.	External contact	8 0 24·6	22 46 4·3	—	—	160
9				Still visible	8 4 33·6	22 50 13·3	—	—	“
10	January 27..........	S	II. Ec. R.	First glimpsed	7 45 27·6	22 31 7·3	—	—	200
11				**Plainly visible**	7 45 29·6	22 31 9·3	22 30 26	— 0 43	
12	January 30..........	S	I. Tr. I.	External contact	7 35 12·0	22 20 51·7	—	—	“
13				About bisected	7 37 48·0	22 23 27·7	—	—	“
14				Internal contact	7 40 51·0	22 26 30·7	—	—	“
15	February 4..........	S	III. Ec. R.	Suspected	7 26 26·0	22 12 5·7	—	—	125
16				Glimpsed	7 26 27·0	22 12 6·7	—	—	“
17				Plainly visible	7 26 40·0	22 12 19·7	22 16 31	+ 4 11	“
18	December 4........	T	I. Tr. E.	Internal contact	9 40 38·1	0 26 17·8	—	—	“
19				External contact	9 45 23·5	0 31 3·2	—	—	“
20	December 9........	T	III. Oc. D.	External contact	8 9 35·1	22 55 14·8	—	—	200
21				About bisected	8 14 40·1	23 0 19·8	—	—	“
22				Disappeared	8 24 13·1a	23 9 52·8	—	—	“
23				Gone	8 25 0·1b	23 10 39·8	—	—	“
24	“	T	III. Oc. R.	First seen	9 36 19·1	0 21 58·8	—	—	“
25				About bisected	9 42 1·1	0 27 40·8	—	—	“
26				External contact	9 48 0·6	0 33 40·3	—	—	“
27	“	S	III. Ec. D.	Still visible	10 29 47·1	1 15 26·8	—	—	“
28				Glimpsed	10 30 23·6	1 16 3·3	1 12 37	— 3 26	“

29	December 11........	T	II. Tr. E.	Internal contact	9 16 27·3	0 2 7·0	—	--	200
30				About bisected	9 18 21·6	0 4 1·3	—	—	"
31				External contact	9 22 16·6	0 7 56·3	—	—	"
32	"	T	I. Tr. I.	External contact	9 18 41·0	0 4 20·7	—	—	"
33				About bisected	9 20 40·7	0 6 20·4	—	—	"
34				Internal contact	9 22 47·3	0 8 27·0	—	—	"
35	December 12........	T	I. Ec. R.	First seen	9 16 38·7	0 2 18·4	0 2 44	+ 0 26	"
36				Full blaze	9 20 37·5	0 6 17·2	—	—	"
37	December 18........	T	II. Tr. I.	External contact	9 17 11·8	0 2 51·5	—	—	"
38				Internal contact	9 21 35·3	0 7 15·0	—	—	"
39	December 19........	T	I. Oc. D.	External contact	8 11 20·1	22 56 59·8	—	—	125
40				Visible through limb	8 15 52·6	23 1 32·3	—	—	"
41				Disappeared	8 16 44·6	23 2 24·3	—	—	"

REMARKS.

Ref. No.	
1	Definition very fair. but observation may be a trifle late.
2 3 4	Moon full, and twilight fairly strong.
5 6 7	Definition good: contact observations considered good. but bisection not good.
8 9	Cloud interfered with observation. External contact is considered fairly good, and at the time marked "still visible" the satellite itself could hardly be seen, but its presence was shown by the appearance of a small angular point on the planet's limb. At that moment definition became very unsteady, and by the time it had steadied again, or at 8h. 4m. 39·6s., A.M.T., no trace of the satellite could be seen.
10 11	Twilight strong.
12 13 14	Definition bad, but observation considered fair.
15 16 17	Very strong twilight. Second magnitude stars only glimpsed with difficulty with naked eye.
18 19	External contact considered good. but limb very unsteady.
20 21 22 23	Between *a* and *b* I caught sight of satellite again, but at *b* it had quite gone.
24 25 26	"First seen." Considered good.
27 28	At time given for "still visible," the definition suddenly became very bad and the satellite was immediately lost sight of. The image did not become fairly still again till 10h. 30m. 23 6s. A.M.T., when the satellite was just glimpsed for a moment and lost sight of again immediately, the definition again becoming very bad. The time given must be very close to the true time of disappearance; the satellite was such a minute speck.
29 30 31	External contact probably a little early.
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35 36	Outline of planet's shadow visible on satellite during emergence.
37 38	Definition variable.
39 40 41	Observation fair.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ LATITUDE, 34° 56′ 38·5″ S.

1894.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used,
					h m s	h m s	h m s	m s	
1	January 3..........	T	III. Tr. I.	External contact	8 16 7·8	23 1 47·5	—	—	125
2				Internal contact	8 28 20·1	23 13 59·8	—	—	"
3	"	T	II. Oc. D.	External contact	8 30 29·7	23 16 9·4	—	—	"
4				Disappeared	8 39 54·8	23 25 34·5	—	—	"
5	"	T	I. Tr. I.	External contact	9 2 41·3	23 48 21·0	—	—	"
6				Internal contact	9 7 56·1	23 53 35·8	—	—	"
7	January 4..........	T	I. Ec. R.	First seen	9 32 51·3	0 18 31·0	0 18 37	– 0 6	"
8				Full blaze	9 37 31·5	0 23 11·2	—	—	"
9	January 19..........	T	II. Tr. I.	External contact	8 11 26·3	22 57 6·0	—	—	200
10				Internal contact	8 16 14·1	23 1 53·8	—	—	"

11	January 19..........	T	I. Sh. I.	Slight indentation	8 25 17·1	23 10 56·8	—	—	200
12				Internal contact	8 29 52·8	23 15 32·5	—	—	"
13	"	T	I. Tr. E.	Internal contact	9 21 45·4	0 7 25·1	—	—	"
14				About bisected	9 23 20·1	0 8 59·8	—	—	"
15				External contact	9 25 57·7	0 11 37·4	—	—	"

REMARKS.

Ref. No.

1, 2 } Definition very bad.

3, 4 } Definition frightful.

5, 6 } Very badly defined and very unsteady.

7, 8 } Observation very good.

Ref. No.

9, 10 } Definition bad. but observation considered pretty good.

11, 12 } Definition bad.

13, 14, 15 } Definition very bad, but observation fair.

Note.—No observations were obtained during the apparitions of 1895 to 1901 inclusive.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. || **LATITUDE, 34° 56′ 38·5″ S.**

1902.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	October 30..........	D	III. Oc. D.	External contact	9 13 23·4	23 59 3·1	—	—	200
2				About bisected	9 15 43·4	0 1 23·1	—	—	"
3				Disappeared	9 18 13·4	0 3 53·1	—	—	"
4	November 1........	D	I. Sh. I.	First seen	7 5 9·4	21 50 49·1	—	—	"
5				Half on	7 5 49·4	21 51 29·1	—	—	"
6				Completely on	7 8 19·4	21 53 59·1	—	—	"
7	"	T	I. Tr.E.	Internal contact	8 3 42·3	22 49 22·0	—	—	"
8				About bisected	8 4 24·3	22 50 4·0	—	—	"
9				External contact	8 5 54·3	22 51 34·0	—	—	"
10	November 14........	D	II. Sh. I.	About half on	8 53 17·1	23 38 56·8	—	—	"
11				Internal contact	8 55 2·1	23 40 41·8	—	—	"
12	November 17........	D	III. Tr. I.	External contact	7 26 5·7	22 11 45·4	—	—	"
13				About bisected	7 27 30·7	22 13 10·4	—	—	"
14				Internal contact	7 29 15·7	22 14 55·4	—	—	"

15 16 17	November 21........	D	II. Tr. I.	External contact About bisected Internal contact	8 54 31·9 8 56 46·9 8 59 11·9	23 40 11·6 23 42 26·6 23 44 51·6	— — —	— — —	200 " "
18 19 20	November 24........	D	I. Sh. I.	First seen Half on Internal contact	7 21 20·2 7 21 50·2 7 22 40·2	22 6 59·9 22 7 29·9 22 8 19·9	— — —	— — —	" " "
21	"	T	I. Tr. E.	External contact	8 24 10·2	23 9 49·9	—	—	"
22 23 24	December 1.........	D	I. Tr. I.	External contact About bisected Internal contact	8 6 5·1 8 7 25·1 8 8 50·1	22 51 44·8 22 53 4·8 22 54 29·8	— — —	— — —	" " "

REMARKS.

Ref. No.	
1 2 3	Very unsteady. Time of disappearance probably too early. The satellite appeared to come back into sight again occasionally after the time of disappearance.
4 5 6	Definition very good. The time for appearance is probably too late. and time of internal contact too late also. The shadow seemed to be elongated until it got clear of the edge. The satellite itself was very distinct a little way past the centre of the disc. It was a little farther S. of the northern cloud belt than the shadow. The spot was also distinct.
7	Definition very variable. Late.
8	Definition very variable.
9	Definition very variable. Good.
10 11	Definition very bad. Could not see the shadow until it was half on. The satellite itself was on the disc, but invisible.
12 13 14	Definition very bad. The shadow of satellite I. was passing across, but could not see anything of it.
15 16 17	Definition fair.
18 19 20	Definition very good indeed. Transit of satellite I. across the disc very plain. The spot just below the southern equatorial belt also very distinct.
21	—
22 23 24	Fairly good observation. Definition fair, but more or less cirro-stratus about.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. || LATITUDE, 34° 56′ 38·5″ S.

1903.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	October 5..........	D	I. Tr. I.	About bisected	7 44 13·3	22 29 53·0	—	—	200
2				Internal contact	7 45 43·3	22 31 23·0	—	—	“
3	“	D	I. Sh. I.	First seen	8 18 43·3	23 4 23·0	—	—	“
4				About half on	8 19 28·3	23 5 8·0	—	—	“
5				Internal contact	8 20 48·3	23 6 28·0	—	—	“
6	October 6..........	B	IV. Ec. R.	First seen	7 37 26·1	22 23 5·8	22 26 15	+ 3 9	“
7				Full blaze	7 40 26·1	22 26 5·8	—	—	“
8	“	B	I. Ec. R.	First seen	7 52 18·1	22 37 57·8	22 38 21	+ 0 23	“
9				Full blaze	7 53 41·1	22 39 20·8	—	—	“
10	October 7..........	B	II. Tr. I.	External contact	7 30 38·6	22 16 18·3	—	—	“
11				About bisected	7 32 38·6	22 18 18·3	—	—	“
12				Internal contact	7 35 8·6	22 20 48·3	—	—	“
13	October 12..........	B	I. Tr. I.	External contact	9 26 57·0	0 12 36·7	—	—	“
14				About bisected	9 29 27·0	0 15 6·7	—	—	“
15				Internal contact	9 31 57·0	0 17 36·7	—	—	“
16	October 14..........	B	IV. Tr. I.	External contact	7 36 22·3	22 22 2·0	—	—	“
17				About bisected	7 39 52·3	22 25 32·0	—	—	“
18				Internal contact	7 43 22·3	22 29 2·0	—	—	“
19	October 20..........	D	I. Oc. D.	First contact	8 32 9·6	23 17 49·3	—	—	“
20				About half on	8 33 39·6	23 19 19·3	—	—	“
21				Disappearance	8 35 39·6	23 21 19·3	—	—	

22	October 20..........	D	III. Tr. E.	Internal contact	9 1 9·6	23 46 49·3	—	—	200
23				About bisected	9 4 9·6	23 49 49·3	—	—	"
24				External contact	9 7 9·6	23 52 49·3	—	—	"
25	"	D	III. Sh. I.	First seen	9 31 39·6	0 17 19·3	—	—	"
26				About bisected	9 33 39·6	0 19 19·3	—	—	"
27				Internal contact	9 38 9·6	0 23 49·3	—	—	"
28	October 21..........	B	I. Tr. E.	Internal contact	7 55 36·9	22 41 16·6	—	—	"
29				About bisected	7 57 6·9	22 42 46·6	—	—	"
30				External contact	7 59 6·9	22 44 46·6	—	—	"
31	October 27..........	D	III. Tr. I.	External contact	9 20 53·8	0 6 33·5	—	—	"
32				About bisected	9 23 53·8	0 9 33·5	—	—	"
33				Internal contact	9 26 53·8	0 12 33·5	—	—	"
34	October 28..........	B	I. Tr. E.	Internal contact	9 43 21·1	0 29 0·8	—	—	"
35				About bisected	9 45 21·1	0 31 0·8	—	—	"
36				External contact	9 47 51·1	0 33 30·8	—	—	"

REMARKS.

Ref. No.	
1 2	Definition poor.
3 4 5	Definition fair.
6 7	Definition very good. Observation considered fair.
8 9	Definition very good. Observation considered good.
10 11 12	Definition bad.
13 14 15	Definition fair.
16 17 18	Definition bad. Limb very unsteady.
19 20 21	Observation good. Definition good on the whole, but unsteady at times. The satellite came momentarily into view again after time of disappearance, but as the limb was unsteady just then the observed time of disappearance may have been too early. Once or twice also the satellite appeared to come right inside the limb of Jupiter like a transit ingress.
22 23 24	Observation not very good. Definition fair.
25 26 27	Observation not very good; definition fair. The time of bisection is probably too soon. and internal contact late.
28 29 30	Definition fair.
31 32 33	Definition fair.
34 35 36	Definition good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
37	October 30..........	D	II. Oc. D.	External contact	8 42 46·1	23 28 25·8	—	—	200
38				About bisected	8 45 16·1	23 30 55·8	—	—	"
39				Disappeared	8 47 16·1	23 32 55·8	—	—	"
40	November 1........	B	II. Sh. E.	Internal contact	8 37 41·3	23 23 21·0	—	—	"
41				About bisected	8 39 41·3	23 25 21·0	—	—	"
42				External contact	8 41 41·3	23 27 21·0	—	—	"
43	November 4........	D	I. Tr. I.	External contact	9 18 59·3	0 4 39·0	—	—	125
44				About bisected	9 19 54·3	0 5 34·0	—	—	"
45				Internal contact	9 21 29·3	0 7 9·0	—	—	"
46	November 5........	B	I. Ec. R.	First seen	10 3 42·0	0 49 21·7	0 49 14·0	— 0 8	200
47				Full blaze	10 5 2·0	0 50 41·7	—	—	"
48	November 7........	D	III. Ec. D.	Entering shadow	7 44 27·1	22 30 6·8	—	—	"
49				About half gone	7 45 37·1	22 31 16·8	—	—	"
50				Disappeared	7 47 7·1	22 32 46·8	22 32 15·0	— 0 32	"
51	November 12........	B	I. Oc. D.	External contact	8 28 25·1	23 14 4·8	—	—	"
52				About bisected	8 29 55·1	23 15 34·8	—	—	"
53				Disappeared	8 31 25·1	23 17 4·8	—	—	"
54	November 13........	D	I. Tr. E.	First contact	7 52 43·3	22 38 23·0	—	—	"
55				About bisected	7 54 13·3	22 39 53·0	—	—	"
56				External contact	7 55 58·3	22 41 38·0	—	—	"
57	"	D	I. Sh. E.	Internal contact	9 6 13·3	23 51 53·0	—	—	"
58	November 17........	D	II. Ec. R.	First seen	8 5 18·7	22 50 58·4	—	—	"
59				Half visible	8 6 53·7	22 52 33·4	—	—	"
60				Full blaze	8 9 3·7	22 54 43·4	—	—	"
61	November 20........	D	I. Tr. I.	External contact	7 29 56·7	22 15 36·4	—	—	"
62				About bisected	7 31 21·7	22 17 1·4	—	—	"
63				Internal contact	7 33 1·7	22 18 41·4	—	—	"
64	December 5........	D	I. Oc. D.	First contact	8 36 57·0	23 22 36·7	—	—	"
65	December 12........	D	IV. Ec. R.	First seen	8 18 12·0	23 3 51·7	—	—	"
66				Half-way out	8 21 22·0	23 7 1·7	—	—	"
67				Full blaze	—	—	—	—	"
68	December 14........	D	I. Ec. R.	First seen	8 39 24·3	23 25 4·0	23 25 1	— 0 3	200
69				Half out (approx.)	8 41 9·3	23 26 49·0	—	—	"
70				Full blaze	8 43 59·3	23 29 39·0	—	—	"

71 72 73	December 17........	D	II. Tr. I.	External contact About bisected Internal contact	8 24 38·0 8 26 48·0 8 29 18·0	23 10 17·7 23 12 27·7 23 14 57·7	— — —	— — —	200 " "
74 75	December 19........	B	II. Ec. R.	First seen Full blaze	7 55 19·8 7 57 54·8	22 40 59·5 22 43 34·5	22 41 21 —	+ 0 21 —	" "
76	December 20........	B	III. Ec. D.	Last seen	8 3 31·8	22 49 11·5	22 48 49	— 0 22	"
77 78 79	"	B	I. Tr. I.	External contact About bisected Internal contact	9 39 51·8 9 41 51·8 9 43 51·8	0 25 31·5 0 27 31·5 0 29 31·5	— — —	— — —	" " "
80	December 21........	B	I. Ec. R.	First seen	10 35 46·3	1 21 26·0	1 20 32	— 0 54	125

REMARKS.

Ref. No.	
37 38 39	Definition very good; image steady. Thin cloud over Jupiter which became dense just at disappearance.
40 41 42	Definition poor. Shadow very faint owing to bright moonlight. External contact probably too early.
43 44 45	Definition very bad; planet flickered at times like a candle burning in the socket. Dome just opened.
46 47	Definition very bad. Observation considered fair.
48 49 50	Observation pretty good. Disappearance correct to a few seconds. The disappearance was not a sharp one, but the satellite gradually got fainter and fainter till just the faintest speck, only visible by straining the eyes, then disappearing.
51 52 53	Definition bad.
54 55 56	Observation good. Definition fairly steady. Time of first contact assumed; did not see it till 30s. after the above time, and it was then a bit off the planet. External contact may be a little late. Planitary detail plainly visible.
57	Observation fair. Definition fairly steady. Lost sight of the shadow after first contact.
58 59 60	Definition very poor. Was looking at another part of field when satellite first appeared, and did not see it till about 5secs. afterwards. In time "first seen" the 5 secs. has been subtracted from actual observed time. Time of full blaze probably late.

Ref. No.	
61 62 63	Definition fair to good. Observation pretty good.
64	Definition so bad that I could hardly see the satellite at all. Time of first contact very approximate. Impossible to distinguish satellite from limb of planet after first contact, as seeing was so blurred and unsteady.
65 66 67	Definition good. Clouds came up before the satellite came out full blaze, and the planet became obscured.
68 69 70	Definition fair. Times of "half out" and "full blaze" very approximate.
71 72 73	Definition fair to good.
74 75	Definition fair, but rather cloudy just at time of reappearance, and so time is probably a few seconds too late.
76	Definition very good. Observation considered good.
77 78 79	Definition good.
80	Definition shocking; the planet was one seething mass. No. I satellite being small and reappearing near the planet it was undoubtedly seen too late. Even after I saw it it seemed to disappear again owing to the very disturbed condition of the atmosphere (the planet was near the horizon).

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

Longitude, 9h. 14m. 20·3s. E. || **Latitude, 34° 56′ 38·5″ S.**

1904.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	January 5...........	D	I. Tr. I.	External contact	8 7 17·2	22 52 56·9	—	—	200
2				About bisected	8 8 42·2	22 54 21·9	—	—	“
3				Internal contact	8 10 42·2	22 56 1·9	—	—	“
4	October 23..........	B	I. Tr. I.	External contact	10 3 28·9	0 49 8·6	—	—	“
5				About bisected	10 5 28·9	0 51 8·6	—	—	“
6				Internal contact	10 7 58·9	0 53 38·6	—	—	“
7	“	B	I. Sh. I.	External contact	10 10 58·9	0 56 38·6	—	—	“
8				About bisected	10 12 13·9	0 57 53·6	—	—	“
9				Internal contact	10 13 28.9	0 59 8·6	—	—	“
10	“	B	II. Oc. D.	External contact	10 45 28·9	1 31 8·6	—	—	“
11				About bisected	10 48 28·9	1 34 8·6	—	—	“
12				Disappeared	10 51 48·9	1 37 28·6	—	—	“
13	October 24..........	B	I. Ec. R.	First seen	9 36 28·7	0 22 8·4	0 22 26	+ 0 18	“
14				Full blaze	9 37 58·7	0 23 38·4	—	—	“
15	November 3........	B	III. Tr. E.	Internal contact	7 25 18·3	22 10 58·0	—	—	“
16				About bisected	7 28 48·3	22 14 28·0	—	—	“
17				External contact	7 33 8·3	22 18 48·0	—	—	“
18	November 9........	D	I. Ec. R.	First seen	7 56 14·9	22 41 54·6	22 42 2	+ 0 7	“
19				About half out	7 57 29·9	22 43 9·6	—	—	“
20				Full blaze	7 58 54·9	22 44 34·6	—	—	“
21	November 10........	B	II. Ec. R.	First seen	7 52 58·9	22 38 38·6	22 40 27	+ 1 48	“
22				Full blaze	7 55 13·9	22 40 53·6	—	—	“

23 24 25	November 15........	D	I. Tr. I.	External contact About half on Internal contact	9 42 30·5 9 43 45·5 9 45 10·5	0 28 10·2 0 29 25·2 0 30 50·2	— — —	— — —	200 " "
26 27 28	November 16........	B	I. Oc. D.	External contact About bisected Last seen	6 56 9·3 6 58 9·3 6 59 49·3	21 41 49·0 21 43 49·0 21 45 29·0	— — —	— — —	" " "
29 30	November 21........	B	III. Ec. R.	First seen Full blaze	7 9 0·1 7 11 5·1	21 54 39·8 21 56 44·8	21 58 32 —	+ 3 52 —	" "
31 32 33	November 24........	B	I. Tr. E.	Internal contact About bisected External contact	8 4 3·7 8 5 33·7 8 7 23·7	22 49 43·4 22 51 13·4 22 53 3·4	— — —	— — —	" " "
34 35 36	"	B	II. Oc. D.	External contact About bisected Disappeared	8 56 3·7 8 58 3·7 9 0 3·7	23 41 43·4 23 43 43·4 23 45 43·4	— — —	— — —	" " "

REMARKS.

Ref. No.	
1 2 3	Definition fair to good.
4 5 6	Definition fairly good.
7 8 9	Definition fairly good.
10 11 12	Definition fairly good. Watched carefully for over a minute after disappearance for a reappearance of the satellite, but failed to see it again.
13 14	Definition good, though observation not very good.
15 16 17	Definition bad.
18 19 20	Definition extremely bad. Planet dancing about all the time. The reappearance took place so near the planet that it was difficult to get a good observation. The time "first seen" is approximate.

Ref. No.	
21 22	Definition rather bad, and observation was not good for reappearance took place about 2min. before calculated time, and so was not keeping a sharp lookout. I saw it when it was very faint and took off 5 secs. to allow for time when just visible.
23 24 25	Definition good.
26 27 28	Definition fairly good. Rather too early in evening for a good observation. The time of satellites disappearance is probably too early because being faint it was lost in the glare of the planet.
29 30	Definition good. Observation considered good.
31 32 33	Definition good.
34 35 36	Definition very good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES—*continued.*

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
37	November 24........	B	I. Sh. E.	Internal contact	8 55 3·7	23 40 43·4	—	—	200
38				About bisected	8 56 33·7	23 42 13·4	—	—	"
39				External contact	8 58 3·7	23 43 43·4	—	—	"
40	November 30........	B	I. Oc. D.	External contact	10 31 54·3	1 17 34·0	—	—	"
41				About bisected	10 33 24·3	1 19 4·0	—	—	"
42				Disappeared	10 35 4·3	1 20 44·0	—	—	"
43	December 1........	B	I. Tr. I.	External contact	7 44 20·3	22 30 0·0	—	—	"
44				About bisected	7 46 5·3	22 31 45·0	—	—	"
45				Internal contact	7 48 0·3	22 33 40·0	—	—	"
46	"	B	I. Tr. E.	Internal contact	9 53 25·7	0 39 5·4	—	—	"
47				About bisected	9 55 5·7	0 40 45·4	—	—	"
48				External contact	9 56 55·7	0 42 35·4	—	—	"
49	"	B	I. Sh. E.	Internal contact	10 51 48·3	1 37 28·0	—	—	"
50				About bisected	10 53 8·3	1 38 48·0	—	—	"
51				External contact	10 54 48·3	1 40 28·0	—	—	"
52	"	B	II. Oc. D.	External contact	11 17 15·3	2 2 55·0	—	—	"
53				About bisected	11 19 15·3	2 4 55·0	—	—	"
54				Disappeared	11 21 45·3	2 7 25·0	—	—	"
55	December 12........	B	II. Ec. R.	First seen	7 34 58·1	22 20 37·8	22 22 55	+ 2 17	"
56				Full blaze	7 36 58·1	22 22 37·8	—	—	"
57	December 17........	D	I. Tr. E.	Half out	8 3 20·3	22 49 0·0	—	—	"
58				External contact	8 5 5·3	22 50 45·0	—	—	"

59	December 17........	D	I. Sh. E.	Internal contact	9 10 50·3	23 56 30·0	—	—	200
60				About half off	9 11 40·3	23 57 20·0	—	—	"
61				External contact	9 12 50·3	23 58 30·0	—	—	"
62	December 19........	B	II. Oc. R.	Internal contact	7 44 59·4	22 30 39·1	—	—	"
63				External contact	7 46 4·4	22 31 44·1	—	—	"
64	"	B	II. Ec. D.	Beginning to grow dim	7 49 44·4	22 35 24·1	—	—	"
65				Disappeared	7 51 19·4	22 36 59·1	22 35 9	− 1 50	"
66	"	B	II. Ec. R.	First seen	10 11 24·5	0 57 4·2	0 59 33	+ 2 29	"
67				Full blaze	10 13 44·5	0 59 24·2	—	—	"

REMARKS.

Ref. No.	
37 38 39	Definition very good.
40 41 42	Definition very good.
43 44 45	Definition very fair.
46 47 48	Definition very good.
49 50 51	Definition good.
52 53 54	Definition good.

Ref. No.	
55 56	Definition fair.
57 58	Observation not very good; time only approximate. Could not distinguish the contacts very well.
59 60 61	Observation not good. Shadow became very indistinct when it reached the edge of the planet. Time probably too early.
62 63	Definition fairly good. The time taken from internal to external contact seems remarkably short; probably the internal contact was late, for the satellite seemed very faint as it came from behind the planet. It was most likely in the penumbra, for a few minutes afterwards it disappeared in the shadow.
64 65	Definition very good.
66 67	Definition good.

OBSERVATIONS OF THE PHENOMENA OF JUPITER'S SATELLITES.

Observation of Eclipses, Occultations, and Transits of Jupiter's Satellites, made with the 8in. Equatorial (Cooke), at the Adelaide Observatory, South Australia.

LONGITUDE, 9h. 14m. 20·3s. E. ‖ **LATITUDE, 34° 56′ 38·5″ S.**

1905.

Reference No.	Date.	Observer.	Phenomenon.	Phase of Phenomenon.	Adelaide Mean Time.	Corresponding Greenwich Mean Time.	Time by *Nautical Almanac.*	Apparent Error of *Nautical Almanac.*	Power Used.
					h m s	h m s	h m s	m s	
1	January 16..........	D	I. Tr. I.	External contact	7 52 30·3	22 38 10·0	—	—	200
2				About half on	7 54 0·3	22 39 40·0	—	—	"
3				Internal contact	7 55 35·3	22 41 15·0	—	—	"
4	"	D	I. Sh. I.	External contact	9 14 20·3	0 0 0·0	—	—	"
5				About half on	9 15 20·3	0 1 0·0	—	—	"
6				Internal contact	9 16 35·3	0 2 15·0	—	—	"
7	January 17..........	D	III. Oc. D.	External contact	8 3 20·3	22 49 0·0	—	—	"
8				About bisected	8 5 50·3	22 51 30·0	—	—	"
9				Disappeared	8 9 20·3	22 55 0·0	—	—	"
10	"	D	I. Ec. R.	About half out	8 46 20·3	23 32 0·0	—	—	"
11				Full blaze	8 47 50·3	23 33 30·0	—	—	"

REMARKS.

Ref. No.	
1, 2, 3	Definition fairly good.
4, 5, 6	Not very good. Definition poor, and shadow hard to distinguish, especially at first contact. Time of first contact probably a little late.
7, 8, 9	Definition fair to bad. The satellite appeared refracted round the corner several times, but limb of planet was not very steady for a good observation. The broad equatorial belt was very distinct, being of a darker color than last year.
10, 11	Missed first appearance. Other observations pretty good.

APPENDIX II.

APPARENT ERRORS OF PREDICTIONS IN NAUTICAL ALMANAC OF THE ECLIPSES OF JUPITER'S SATELLITES.

Date.	I.		II.		III.		IV.	
	D.	R.	D.	R.	D.	R.	D.	R.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1876.								
June 22	—	+ 0·11	—	—	—	—	—	—
" 23	—	—	—	—	—	+ 3·42	—	—
" 25	—	—	—	+ 2·46	—	—	—	—
" 29	—	— 0·5	—	—	—	—	—	—
July 13	—	+ 0·22	—	+ 2·38	—	—	—	—
" 20	—	—	—	+ 2·53	—	—	—	—
Aug. 12	—	—	—	—	— 5·5	+ 4·7	—	—
" 14	—	+ 0·30	—	+ 2·32	—	—	—	—
" 21	—	+ 0·14	— 0·41	+ 2·7	—	—	—	—
" 30	—	+ 0·29	—	—	—	—	—	—
Sept. 6	—	+ 0·28	—	—	—	+ 4·38	—	—
" 17	—	—	—	—	—	—	—	—
" 22	—	+ 0·24	—	+ 2·8	—	—	—	—
" 24	—	—	—	—	— 3·39	—	—	—
Oct. 15	—	+ 0·22	—	—	—	—	—	—
1877.								
June 9	— 0·22	—	—	—	— 1·34	—	—	—
" 12	—	—	— 0·33	—	—	—	—	—
" 16	— 0·32	—	—	—	— 2·1	—	—	—
" 25	—	+ 0·18	—	—	—	—	—	—
July 7	—	—	—	+ 1·28	—	—	—	—
" 11	—	+ 0·20	—	—	—	—	—	—
" 14	—	—	—	+ 1·32	—	—	—	—
" 21	—	—	—	+ 1·53	—	—	—	—
" 22	—	—	—	—	— 1·22	+ 4·12	—	—
Aug. 8	—	—	—	+ 1·37	—	—	—	—
" 15	—	—	—	+ 1·37	—	—	—	—
" 26	—	+ 0·30	—	—	—	—	—	—
Oct. 11	—	+ 0·10	—	—	—	—	—	—
Nov. 4	—	—	—	—	—	—	— 5·45	—
1878.								
July 21	— 0·26	—	—	—	—	—	—	—
" 22	—	—	+ 0·4	—	—	—	—	—
Aug. 9	—	—	—	+ 0·47	—	—	—	—
" 13	—	+ 0·7	—	—	—	+ 3·16	—	—
Sept. 25	—	+ 0·13	—	—	—	+ 3·39	—	—
Oct. 2	—	—	—	—	+ 0·25	—	—	—
" 5	—	—	—	—	—	—	+ 2·2	—
" 23	—	+ 0·2	—	—	—	—	—	—
Nov. 7	—	—	—	—	—	+ 3·26	—	—
" 15	—	+ 0·5	—	—	—	—	—	—
Dec. 11	—	—	—	—	—	—	+ 3·8	—
1879.								
Sept. 10	—	+ 0·12	—	—	—	—	—	—
" 26	—	+ 0·7	—	—	—	—	—	—
Oct. 3	—	+ 0·14	—	—	—	—	—	—
" 13	—	—	—	+ 1·10	—	—	—	—
" 17	—	—	—	—	+ 0·59	—	—	—

APPARENT ERRORS—*continued.*

Date.	I.		II.		III.		IV.	
	D.	R.	D.	R.	D.	R.	D.	R.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1880.								
Oct. 14	—	+ 0·25	—	—	—	—	—	—
Nov. 29	—	+ 0·31	—	—	—	—	—	—
Dec. 9	—	—	—	+ 1·46	—	—	—	—
" 20	—	—	—	—	—	+ 4·31	—	—
" 22	—	+ 0·14	—	—	—	—	—	—
1881.								
Jan. 30	—	— 0·29	—	—	—	—	—	—
Feb. 11	—	—	—	+ 0·20	—	—	—	—
Dec. 3	—	—	—	+ 0·51	—	—	—	—
" 11	—	—	—	+ 0·27	—	—	—	—
1882.								
Jan. 4	—	—	—	+ 0·40	—	+ 7·51	—	—
1883.								
Jan. 26	—	—	—	—	—	+ 2·32	—	—
" 30	—	—	—	+ 0·13	—	—	—	—
" 31	—	+ 0·20	—	—	—	—	—	—
Feb. 2	—	—	—	—	— 2·24	—	—	—
" 23	—	+ 0·19	—	—	—	—	—	—
March 3	—	—	—	— 0·3	—	—	—	—
1884.								
Jan. 27	—	+ 0·11	—	—	—	—	—	—
Feb. 19	—	+ 0·21	—	—	—	—	—	—
March 3	—	—	—	+ 0·18	—	—	—	—
" 13	—	+ 0·24	—	—	—	—	—	—
" 31	—	—	—	—	—	— 0·17	—	—
April 4	—	—	—	+ 0·24	—	—	—	—
" 7	—	—	—	—	—	—	— 4·12	—
" 21	—	— 0·2	—	—	—	—	—	—
May 6	—	—	—	— 0·13	—	—	—	—
1885.								
Feb. 21	—	— 0·8	—	—	—	—	—	—
" 25	—	—	—	+ 0·17	—	—	—	—
" 28	—	— 0·1	—	—	—	—	—	—
March 2	—	— 0·18	—	—	—	—	—	—
" 4	—	—	—	+ 0·26	—	—	—	—
" 8	—	—	—	—	—	—	—	+ 0·22
" 9	—	+ 0·9	—	—	—	—	—	—
" 10	—	—	—	—	—	+ 0·23	—	—
" 16	—	+ 0·15	—	—	—	—	—	—
" 17	—	—	—	—	—	— 0·23	—	—
" 18	—	+ 0·5	—	—	—	—	—	—
April 1	—	+ 0·16	—	—	—	—	—	—
" 10	—	+ 0·5	—	—	—	—	—	—
" 29	—	—	—	—	— 3·51	— 1·14	—	—
" 30	—	—	—	+ 0·46	—	—	—	—
May 10	—	— 0·4	—	—	—	—	—	—
June 1	—	—	—	+ 0·37	—	—	—	—
" 11	—	— 0·11	—	—	— 3·5	—	—	—
Nov. 1	—	—	—	—	— 3·18	—	—	—
Dec. 1	— 0·34	—	—	—	—	—	—	—
" 13	—	—	— 1·31	—	—	—	—	—
" 14	—	—	—	—	— 4·9	—	—	—

APPARENT ERRORS—*continued.*

Date.	I.		II.		III.		IV.	
	D.	R.	D.	R.	D.	R.	D.	R.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1886.								
Jan. 9	− 0·52	—	—	—	—	—	—	—
" 14	—	—	− 1·31	—	—	—	—	—
" 16	− 0·51	—	—	—	—	—	—	—
" 20	—	—	—	—	—	—	+ 6·30	− 2·46
" 25	− 0·52	—	—	—	—	—	—	—
" 26	—	—	—	—	− 4·4	—	—	—
Feb. 8	− 0·49	—	− 1·31	—	—	—	—	—
" 15	—	—	− 0·49	—	—	—	—	—
" 17	− 1·48	—	—	—	—	—	—	—
" 22	—	—	− 1·19	—	—	—	—	—
" 24	− 0·46	—	—	—	—	—	—	—
March 5	− 0·31	—	—	—	—	—	—	—
" 10	—	—	—	—	− 4·28	—	—	—
" 12	—	—	− 0·48	—	—	—	—	—
" 19	− 0·38	—	− 0·54	—	—	—	—	—
" 28	—	+ 0·3	—	—	—	—	—	—
April 6	—	+ 0·19	—	+ 0·47	—	—	—	—
' 8	—	—	—	—	—	− 0·7	—	—
" 13	—	+ 0·15	—	—	—	—	—	—
" 14	—	—	—	—	—	—	+ 10·18	− 5·52
" 15	—	—	—	—	—	− 0·11	—	—
" 20	—	+ 0·17	—	—	—	—	—	—
" 29	—	+ 0·7	—	—	—	—	—	—
May 6	—	+ 0·2	—	—	—	—	—	—
" 14	—	—	—	—	—	+ 0·19	—	—
June 14	—	+ 0·10	—	—	—	—	—	—
" 30	—	+ 0·7	—	—	—	—	—	—
1887.								
April 7	—	—	− 0·36	—	—	—	—	—
" 16	− 0·54	—	—	—	—	—	—	—
" 30	—	—	—	—	—	+ 2·37	—	—
May 18	—	+ 0·21	—	—	—	—	—	—
July 12	—	+ 0·34	—	− 0·22	—	—	—	—
" 19	—	+ 0·10	—	—	—	—	—	—
" 25	—	—	—	—	− 7·31	+ 2·46	—	—
1888.								
April 4	− 1·1	—	—	—	—	—	—	—
" 7	—	—	+ 0·16	—	—	—	—	—
" 20	− 0·48	—	—	—	—	—	—	—
May 9	—	—	+ 0·13	—	—	—	—	—
" 28	—	—	—	—	—	+ 3·28	—	—
July 3	—	—	—	—	—	+ 4·48	—	—
" 30	—	+ 0·30	—	− 0·37	—	—	—	—
Aug. 15	—	+ 0·43	—	—	—	+ 3·34	—	—
" 22	—	—	—	—	− 4·32	+ 3·28	—	—
1889.								
May 14	—	—	—	—	− 2·46	—	—	—
" 16	− 0·50	—	—	—	—	—	—	—
July 3	—	+ 0·2	—	—	—	—	—	—
" 10	—	+ 0·4	—	—	—	—	—	—
" 16	—	—	—	—	—	—	− 23·1	—
" 19	—	+ 0·11	—	—	—	—	—	—

APPARENT ERRORS—*continued.*

Date.	I.		II.		III.		IV.	
	D.	R.	D.	R.	D.	R.	D.	R.
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1889.								
Aug. 1	—	—	—	—	− 1·27	—	—	—
" 2	—	—	—	—	—	—	− 11·24	—
Sept. 13	—	—	—	—	—	+ 3·2	—	—
" 21	—	—	—	—	—	—	− 4·10	—
1892.								
Nov. 7	—	+ 0·6	—	—	—	—	—	—
" 17	—	—	—	—	− 0·43	—	—	—
" 30	—	− 0·12	—	—	—	—	—	—
1893.								
Jan. 2	—	—	+ 1·3	—	—	—	—	—
" 27	—	—	—	− 0·43	—	—	—	—
Feb. 4	—	—	—	—	—	+ 4·11	—	—
Dec. 9	—	—	—	—	− 3·26	—	—	—
" 12	—	+ 0·26	—	—	—	—	—	—
1894.								
Jan. 4	—	+ 0·6	—	—	—	—	—	—
1903.								
Oct. 6	—	+ 0·23	—	—	—	—	—	+ 3·9
Nov. 5	—	− 0·8	—	—	—	—	—	—
" 7	—	—	—	—	− 0·32	—	—	—
Dec. 14	—	− 0·3	—	—	—	—	—	—
" 19	—	—	—	+ 0·21	—	—	—	—
" 20	—	—	—	—	− 0·22	—	—	—
" 21	—	− 0·54	—	—	—	—	—	—
1904.								
Oct. 24	—	+ 0·18	—	—	—	—	—	—
Nov. 9	—	+ 0·7	—	—	—	—	—	—
" 10	—	—	—	+ 1·48	—	—	—	—
" 21	—	—	—	—	—	+ 3·52	—	—
Dec. 12	—	—	—	+ 2·17	—	—	—	—
" 19	—	—	− 1·50	+ 2·29	—	—	—	—

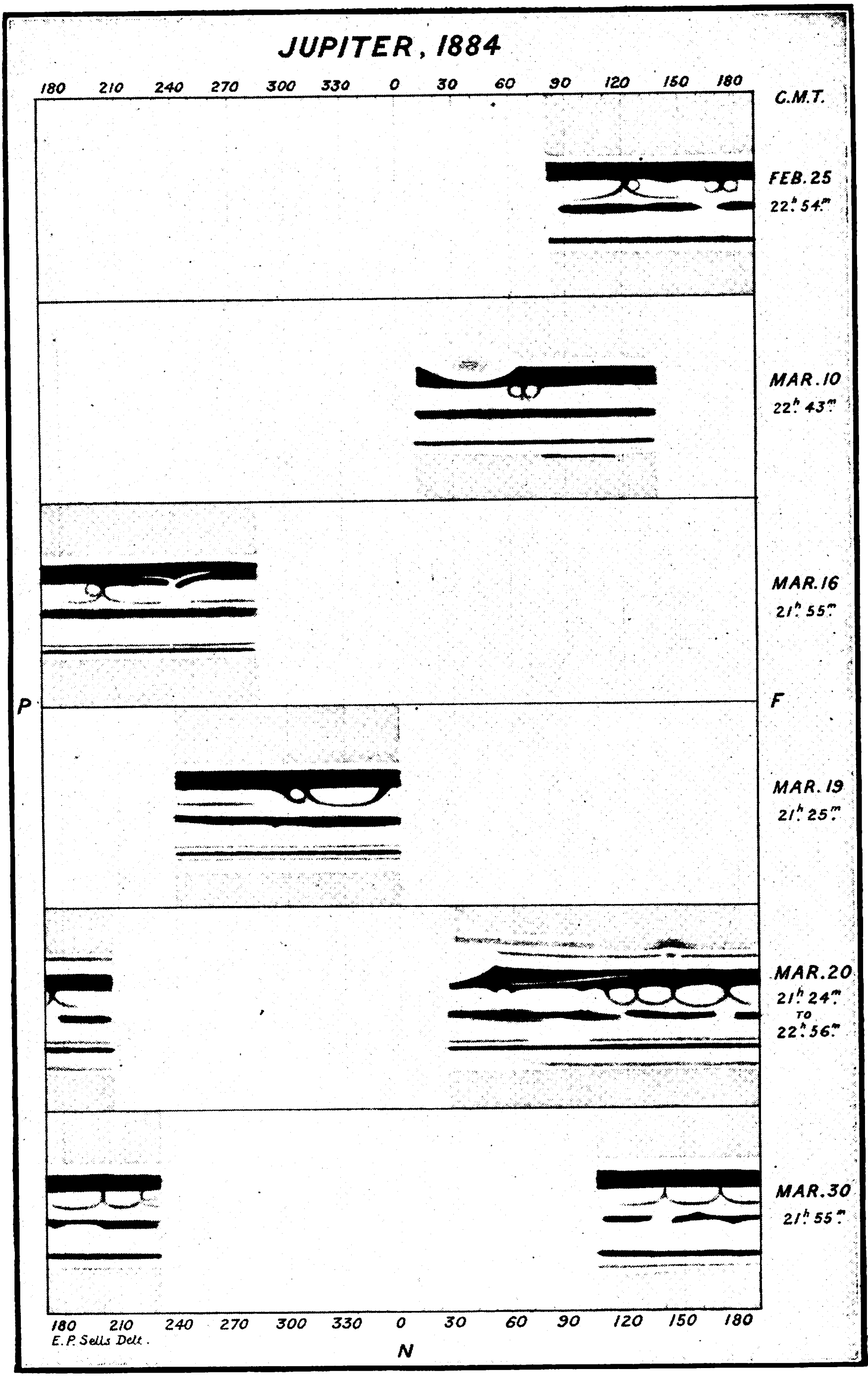


Plate I.

UNIV. OF MICH.

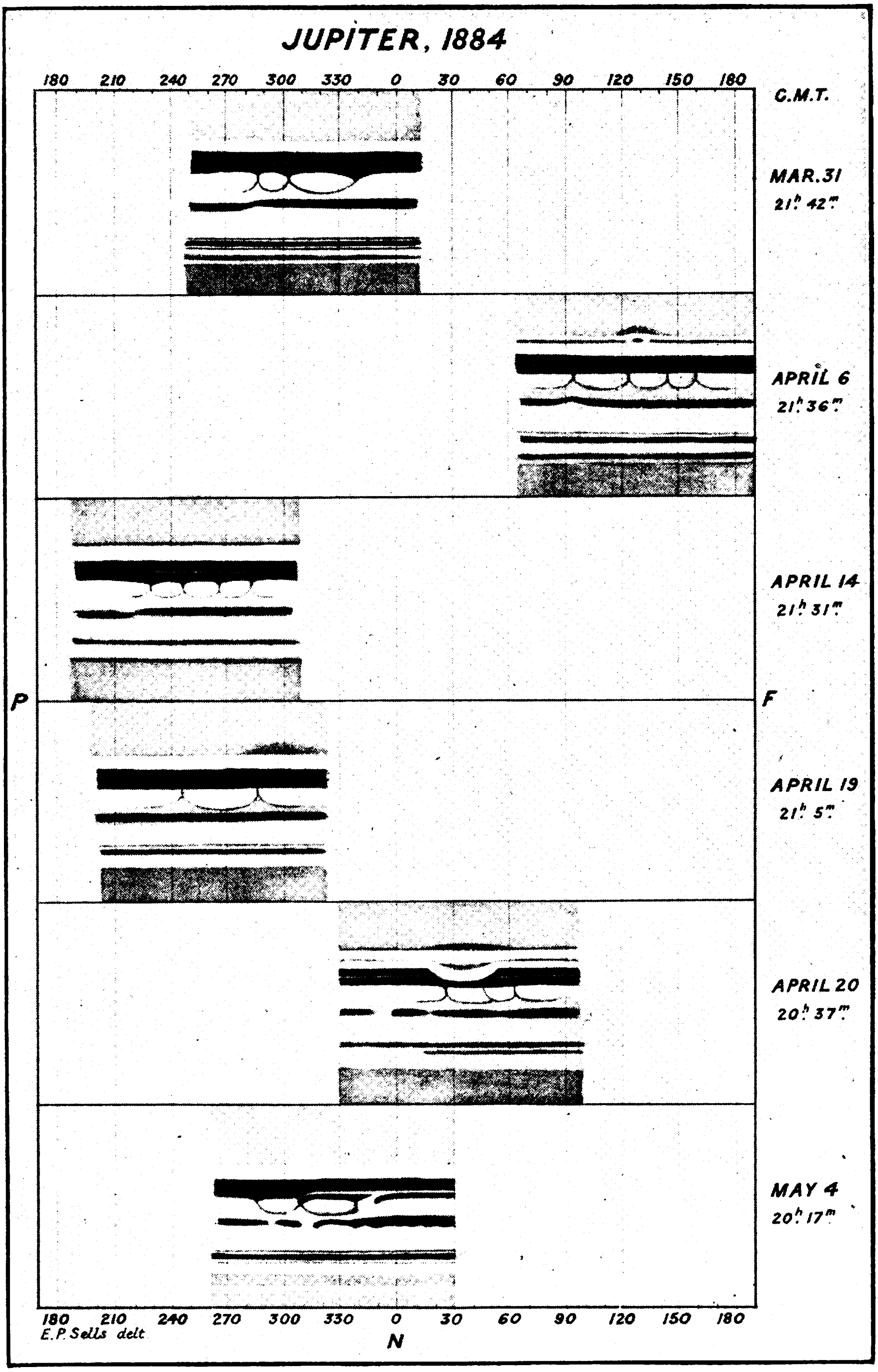

JUPITER, 1884
180 210 240 270 300 330 0 30 60 90 120 150 180
C.M.T.
MAR. 31
21h 42m
APRIL 6
21h 36m
APRIL 14
21h 31m
P
F
APRIL 19
21h 5m
APRIL 20
20h 37m
MAY 4
20h 17m
180 210 240 270 300 330 0 30 60 90 120 150 180
E. P. Sells delt
N

Plate II.

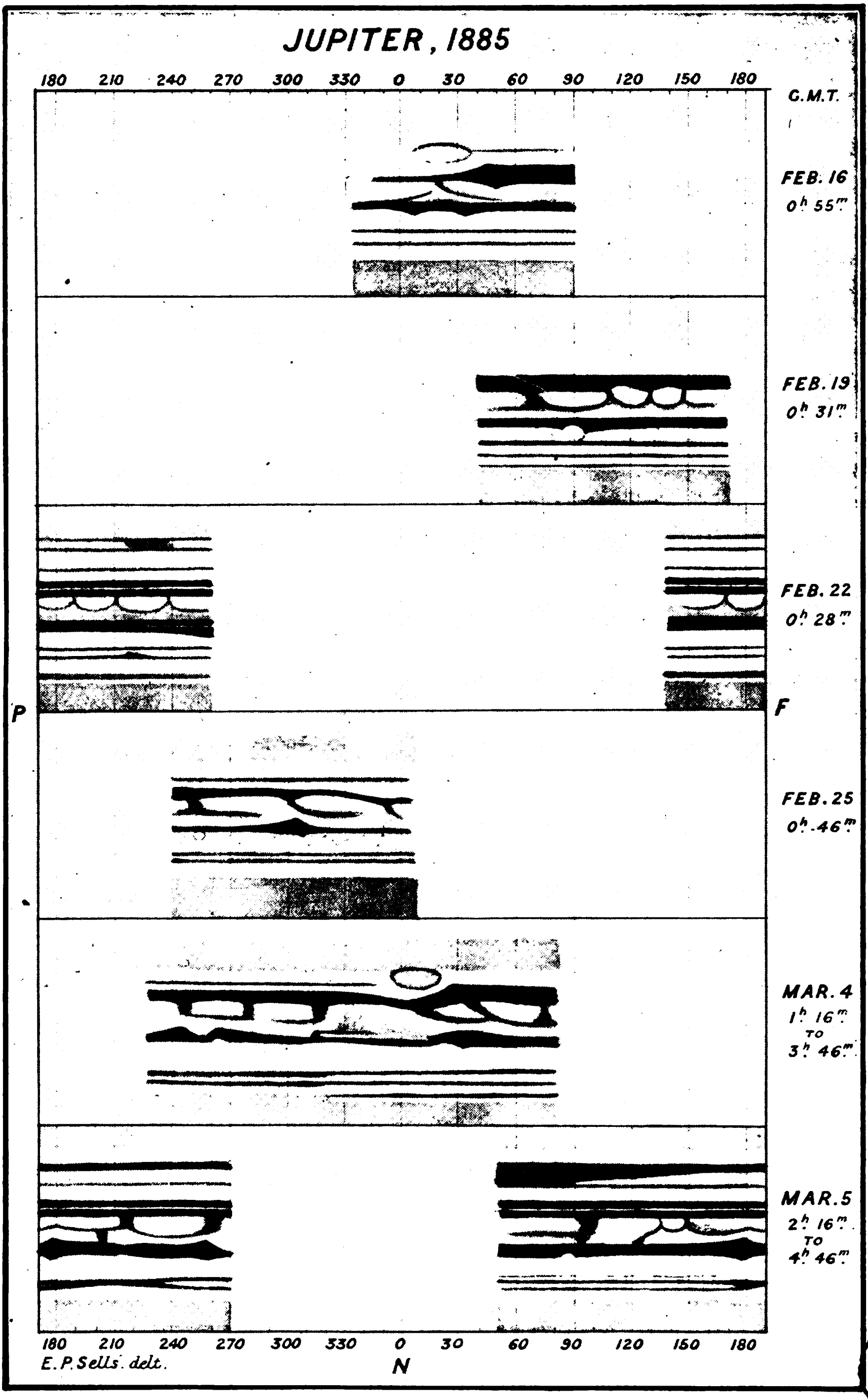
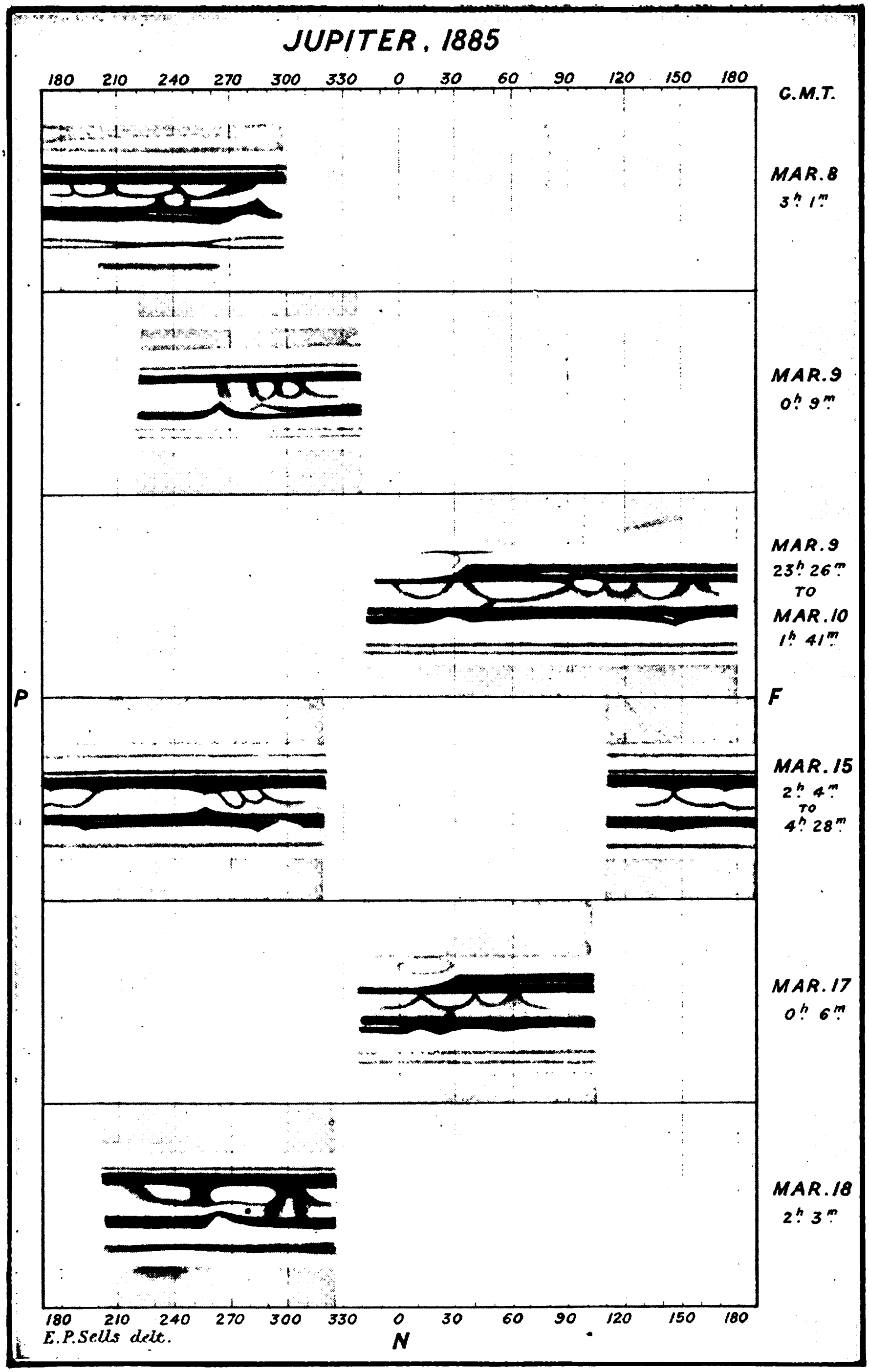


Plate III.

UNIV. OF MICH.



JUPITER, 1885

E. P. Sells delt.

Plate IV.

UNIV. OF MICH.

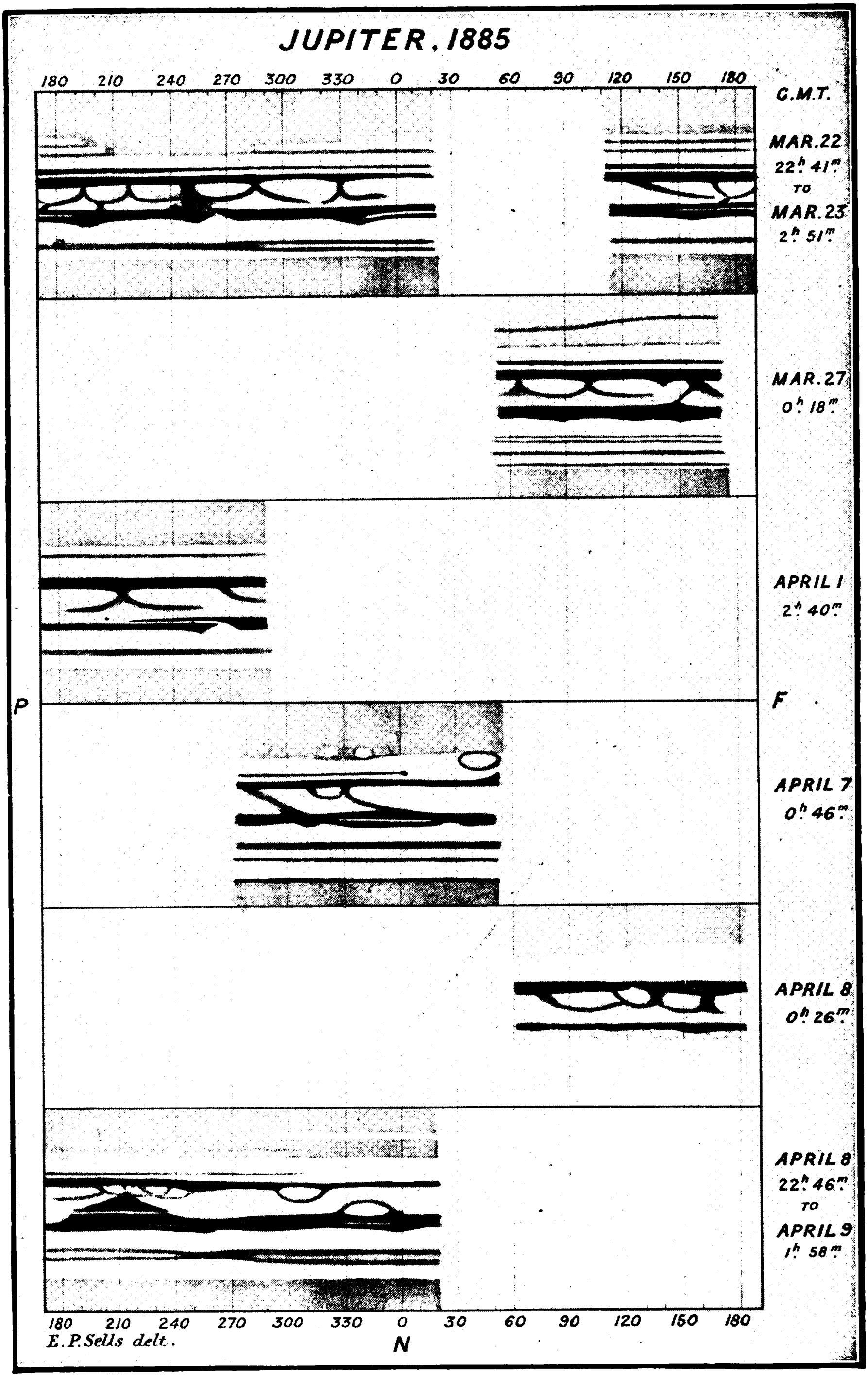
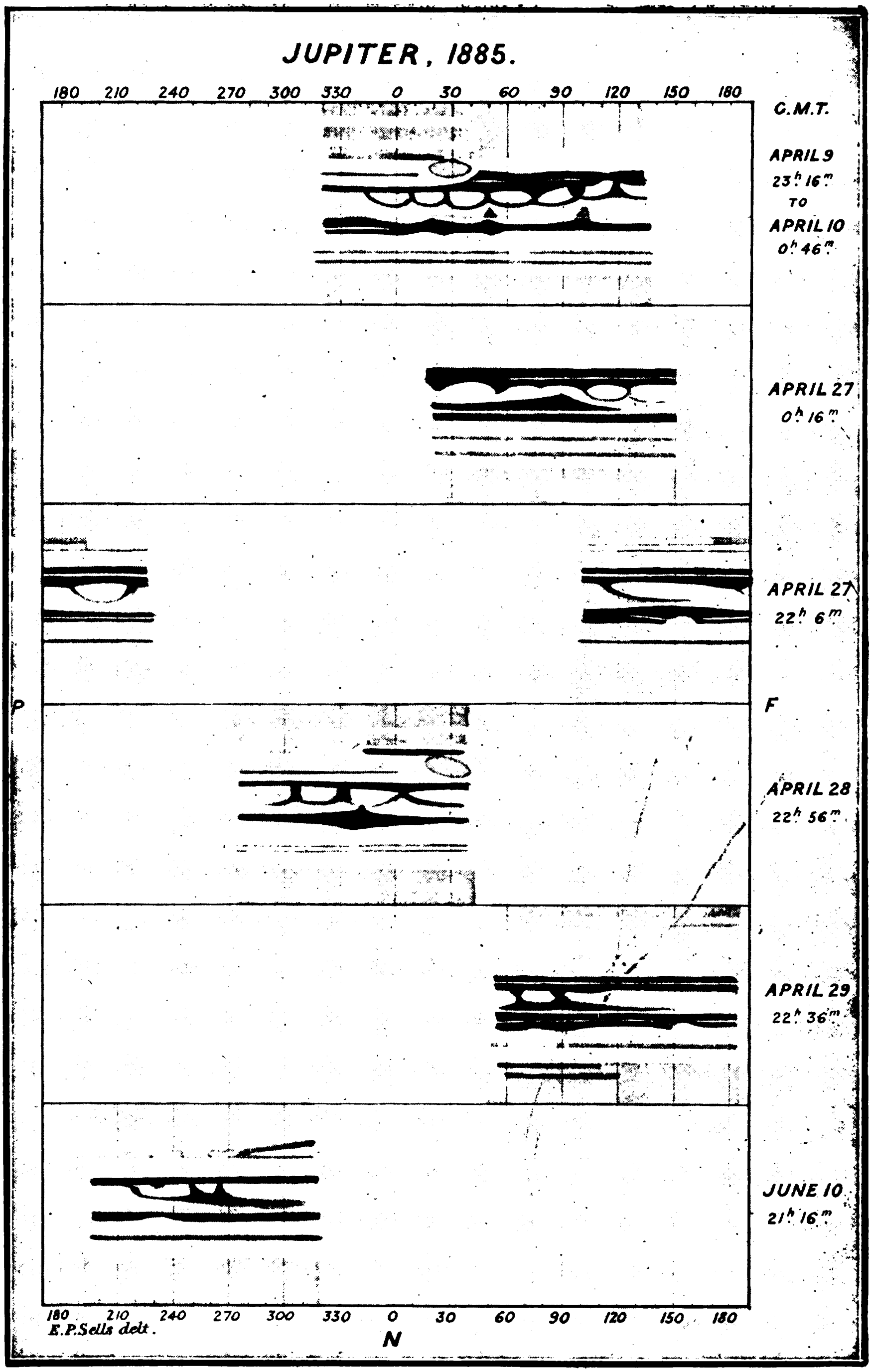


Plate V.

UNIV. OF MICH.



JUPITER, 1885.

Plate VI.

UNIV. OF MICH.

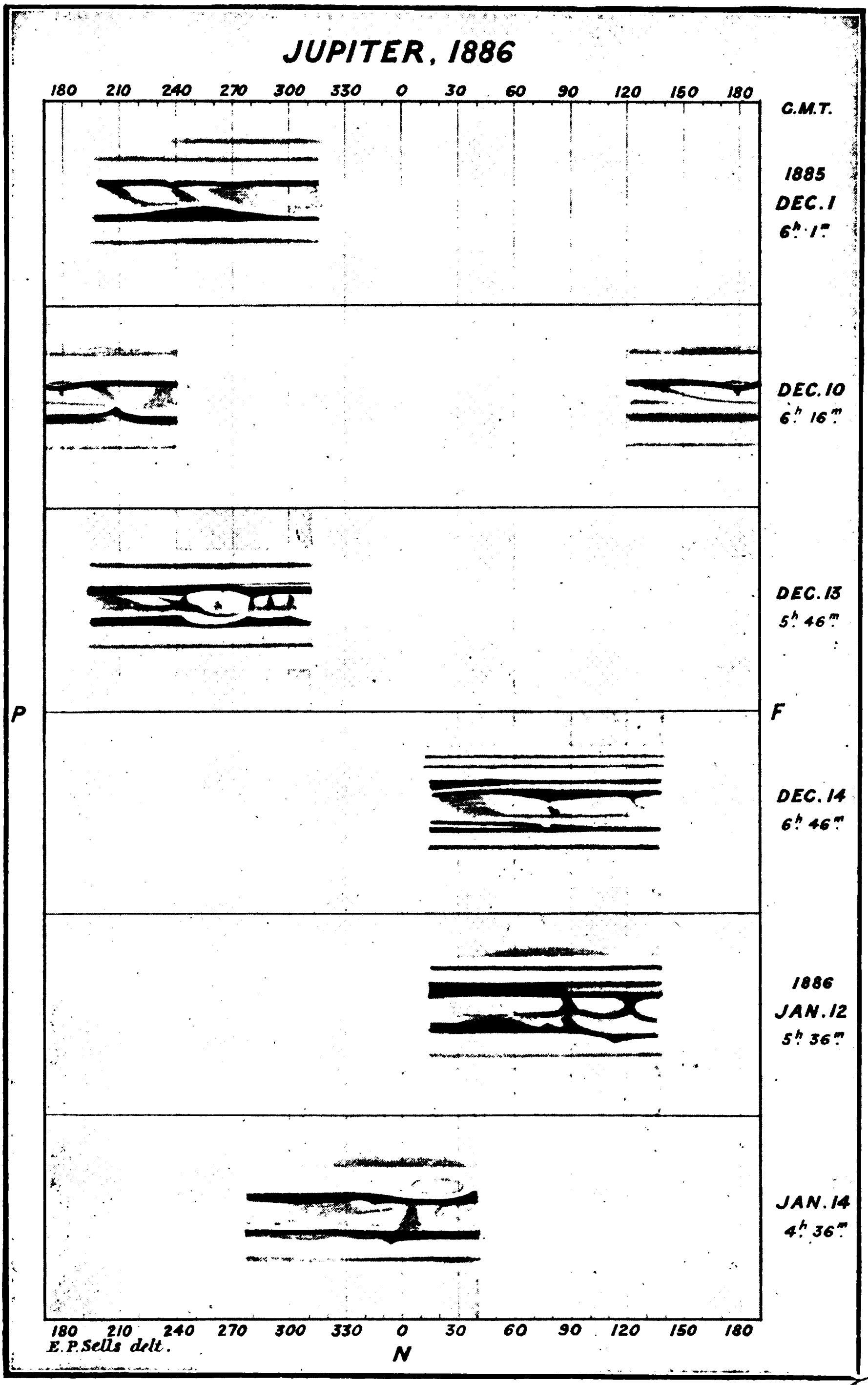


Plate VII.

UNIV. OF MICH.

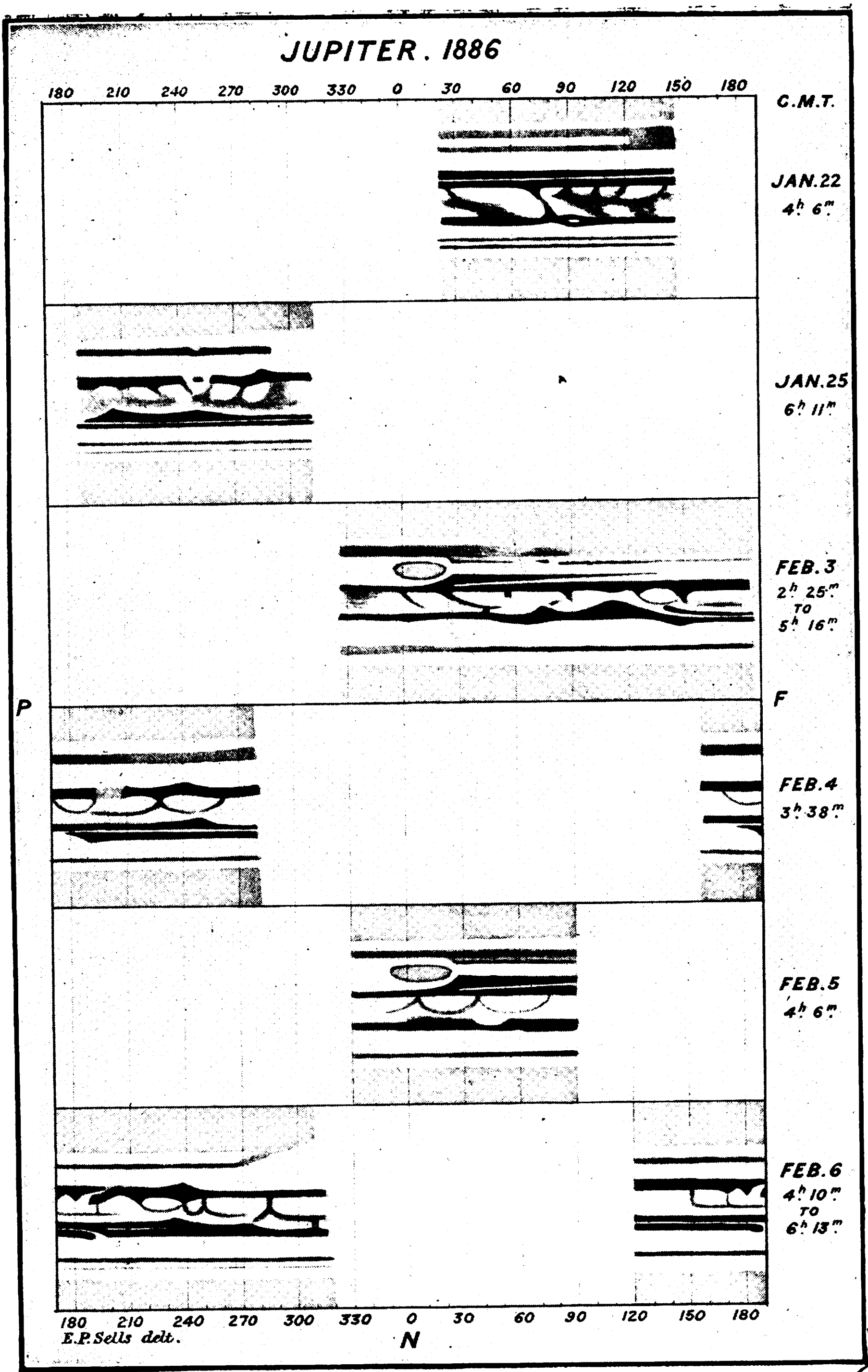


Plate VIII

UNIV. OF MICH.

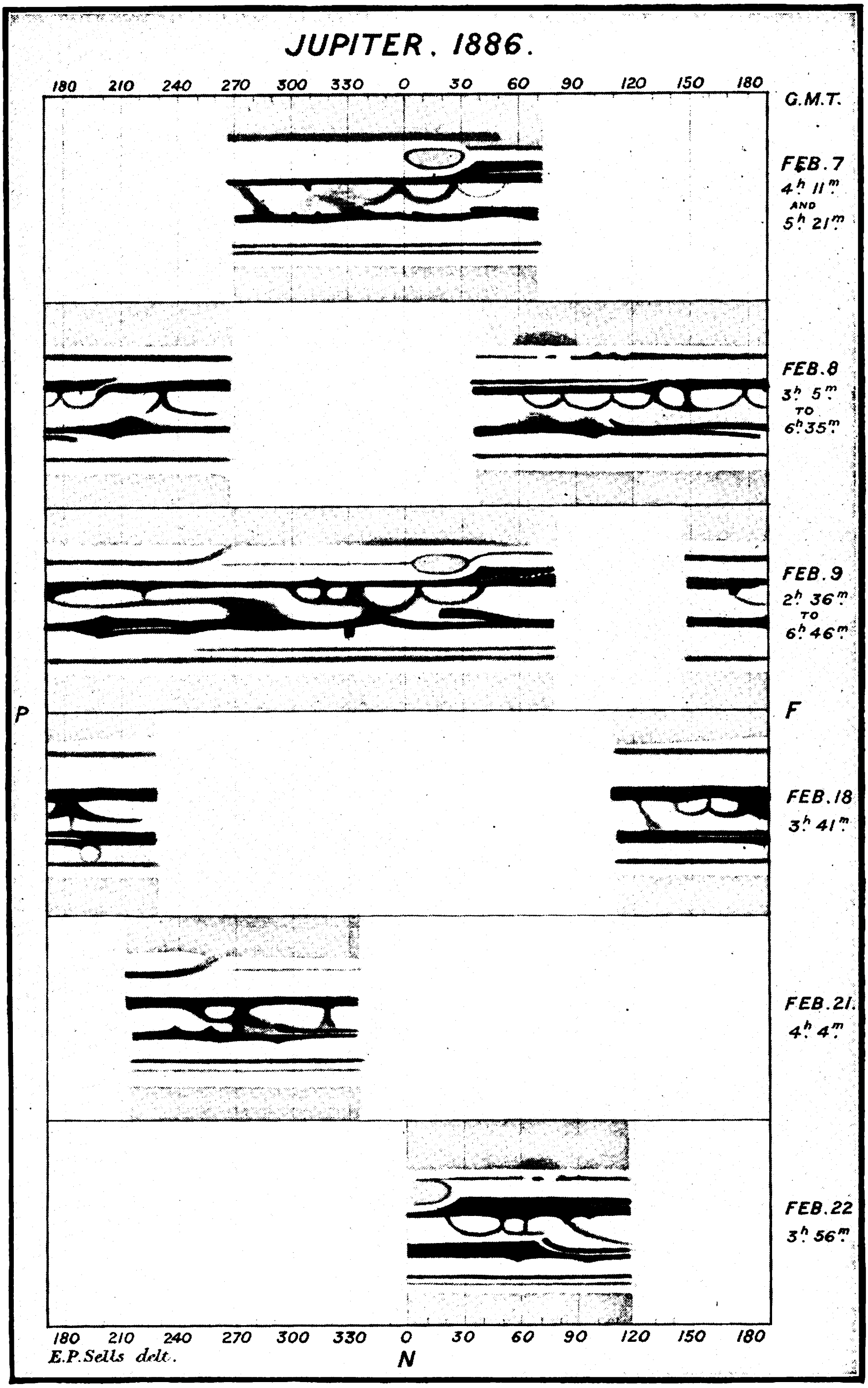


Plate IX.

UNIV. OF MICH.

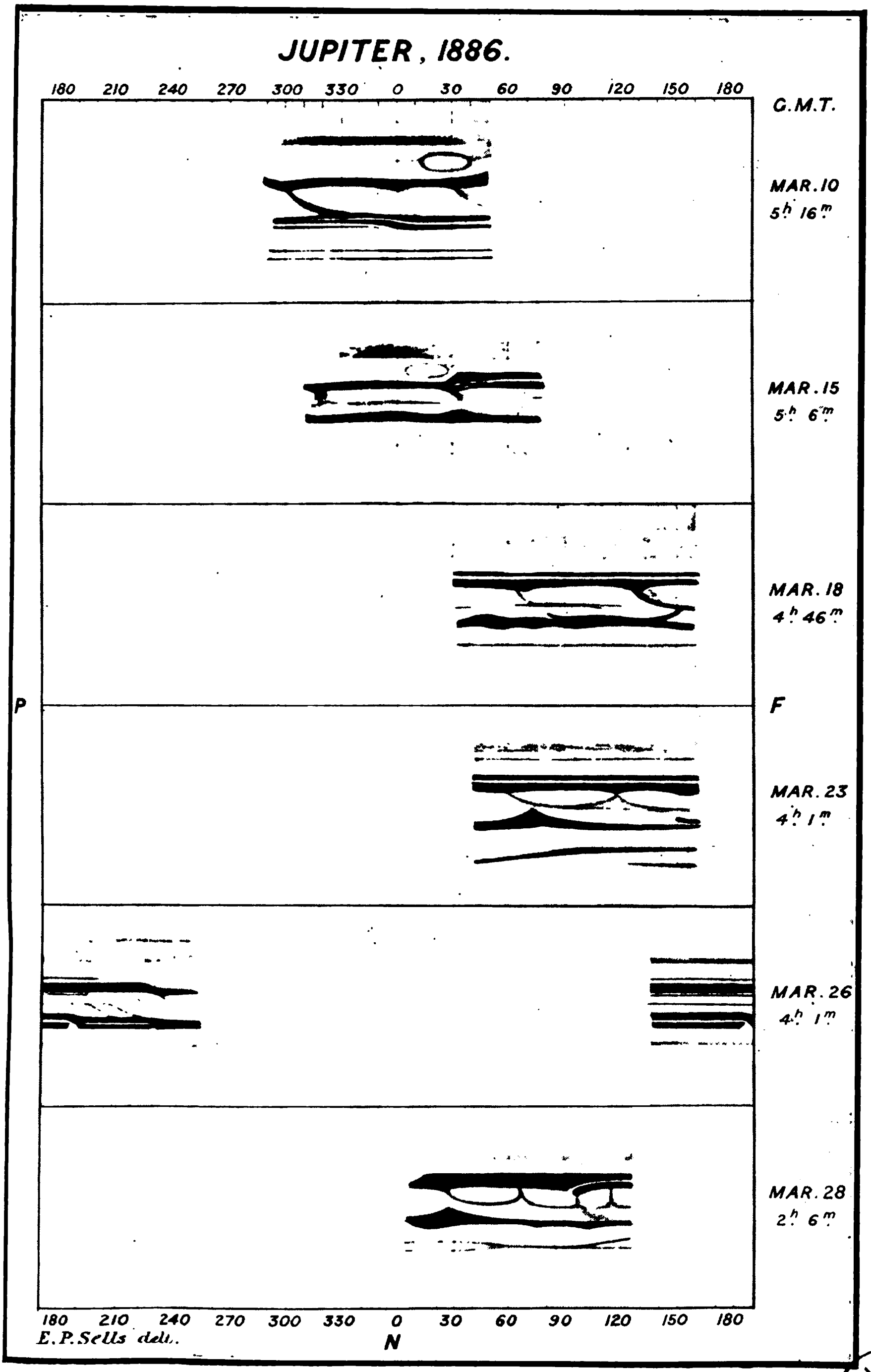


Plate X.

UNIV. OF MICH.

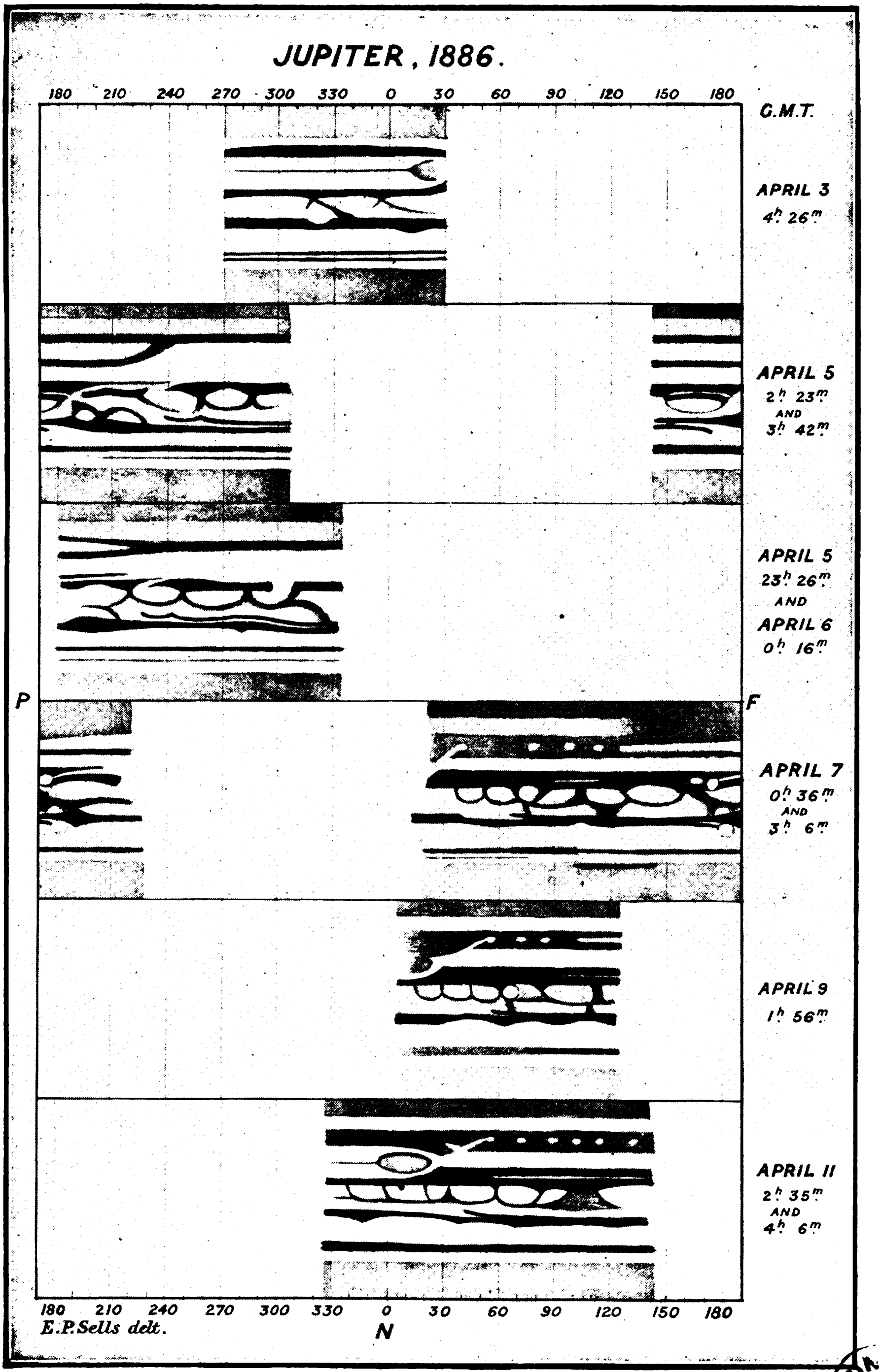


Plate XI.

UNIV. OF MICH.

JUPITER. 1886.

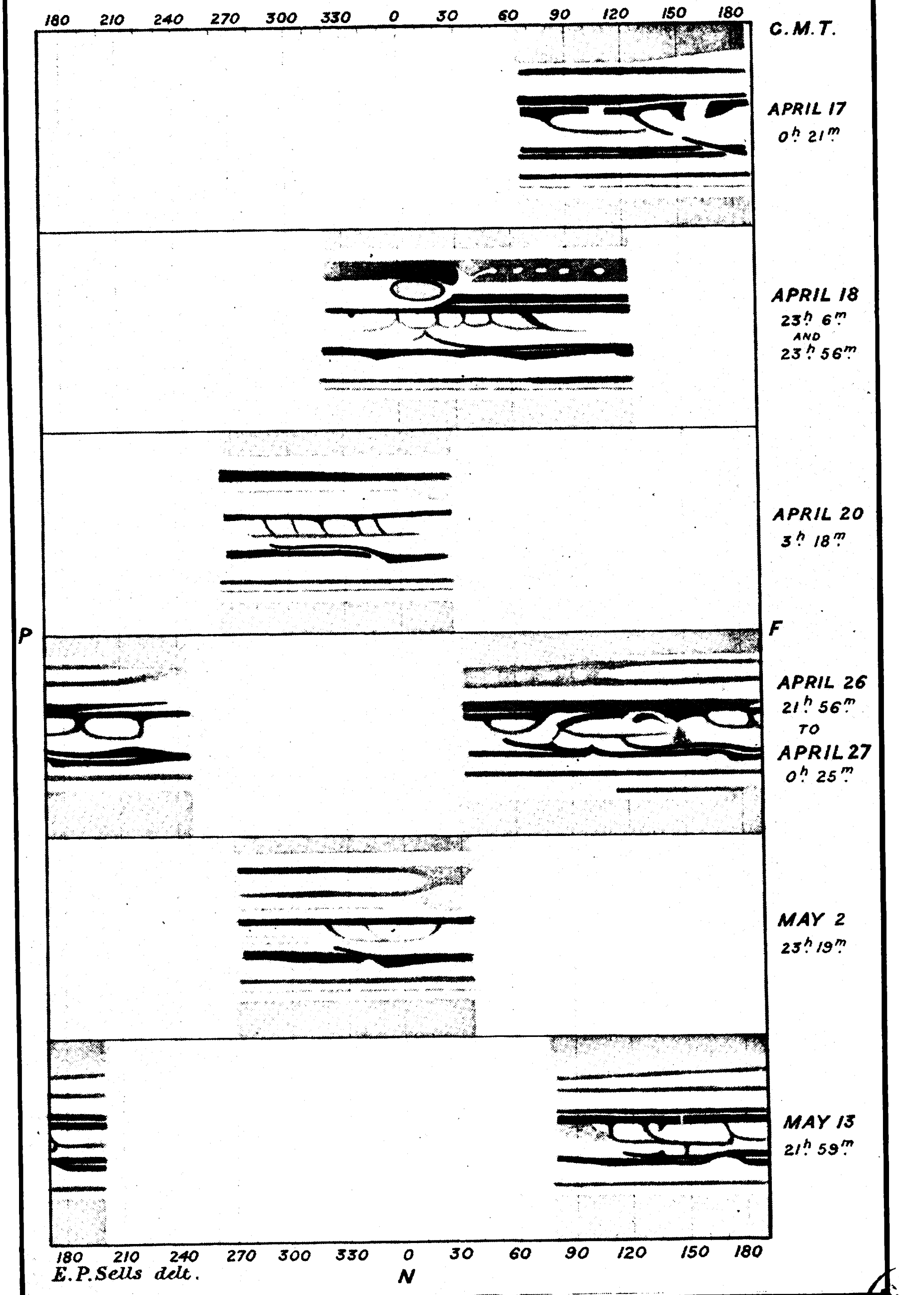


Plate XII.

OF MICH.

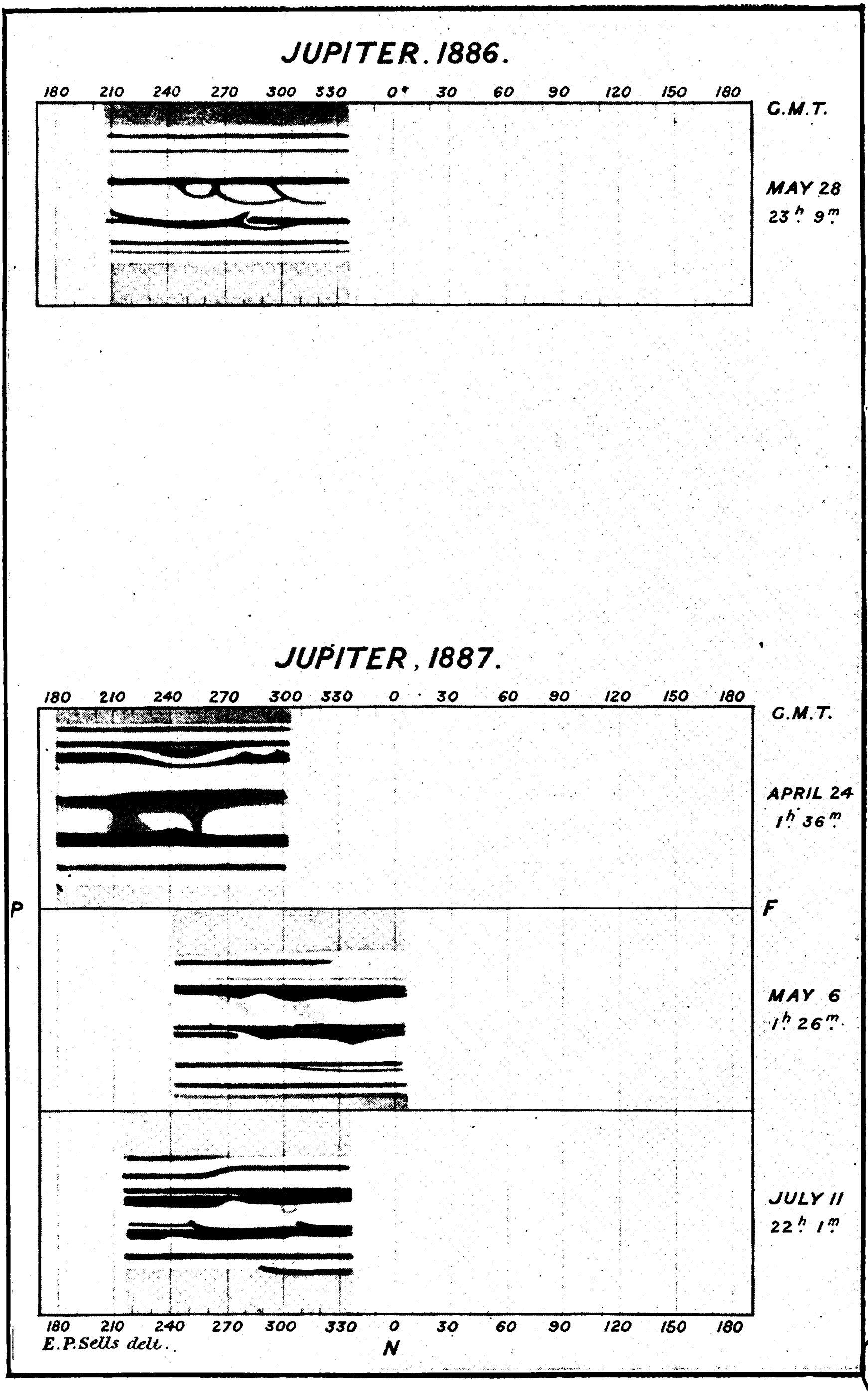


Plate XIII.

UNIV. OF MICH.

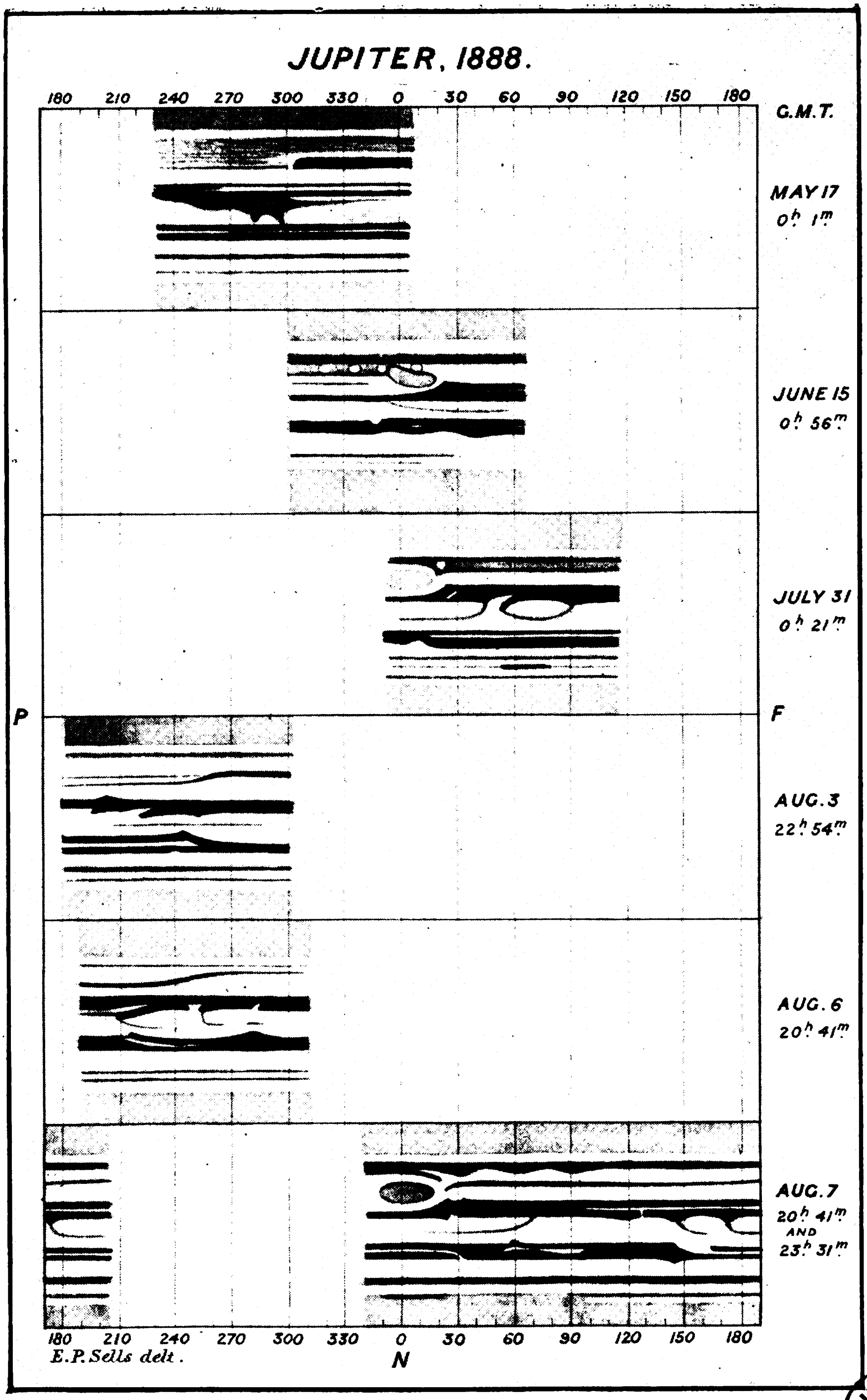


Plate XIV.

UNIV. OF MICH.

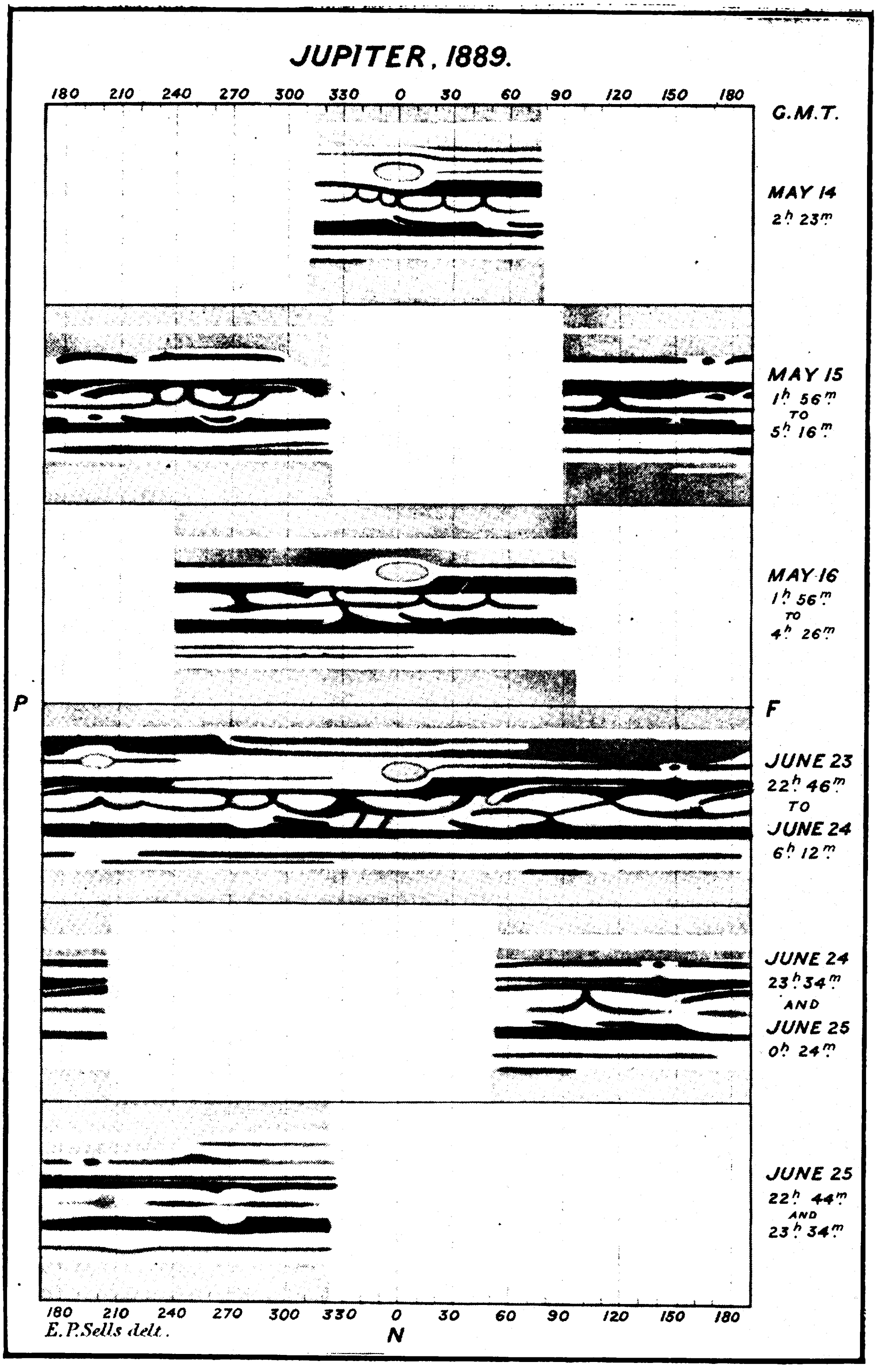


Plate XV.

UNIV. OF MICH.

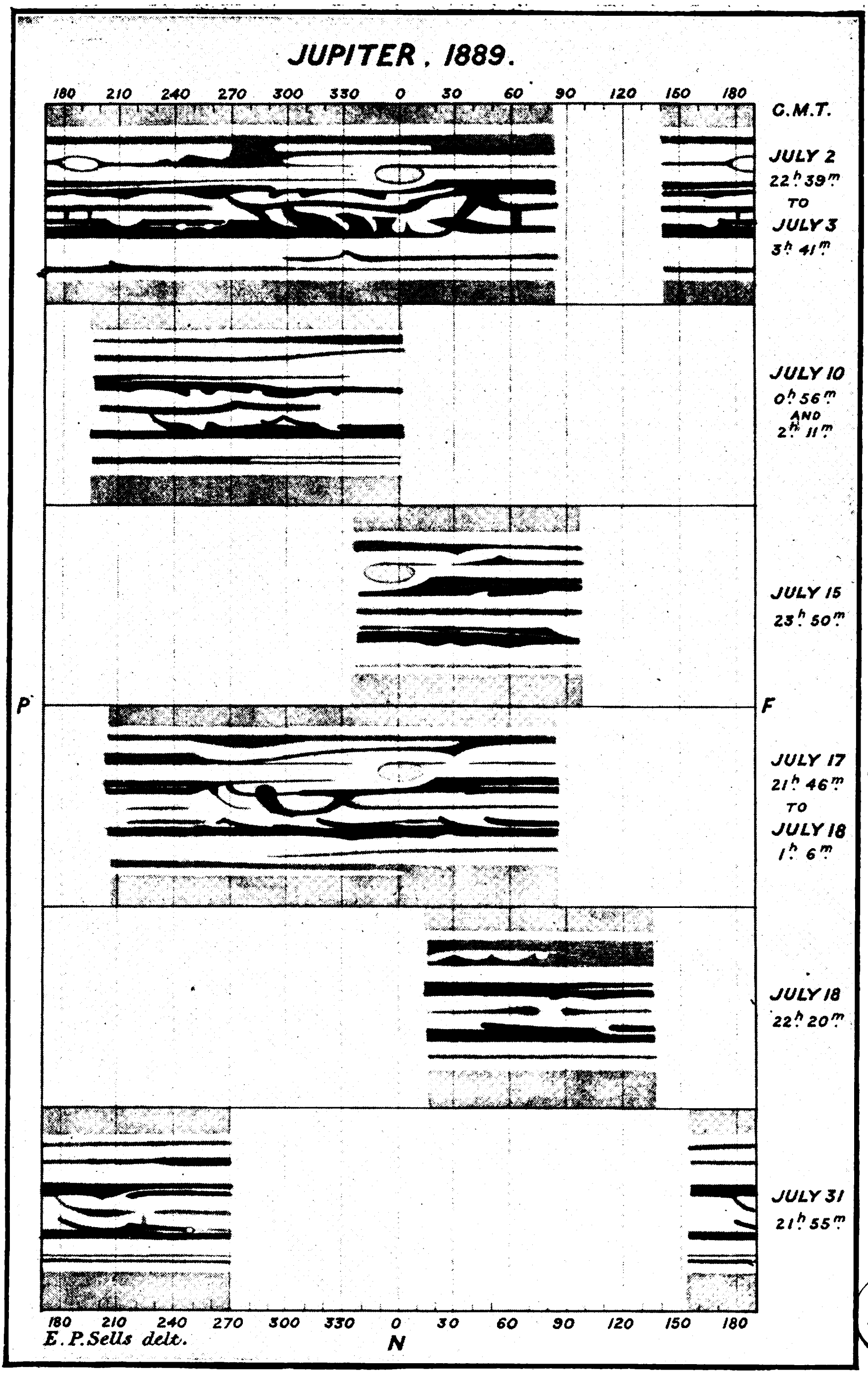


Plate XVI.

UNIV. OF MICH.

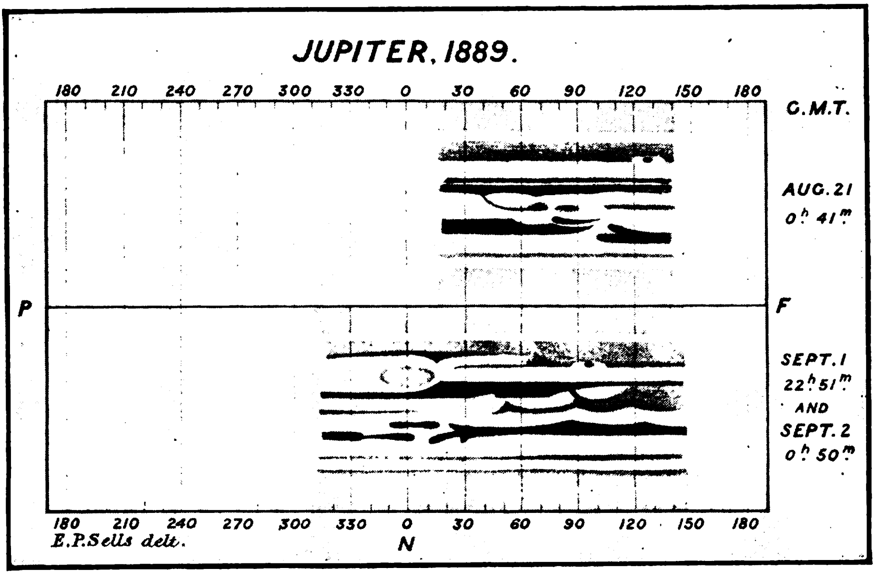


Plate XVII.

UNIV. OF MICH.

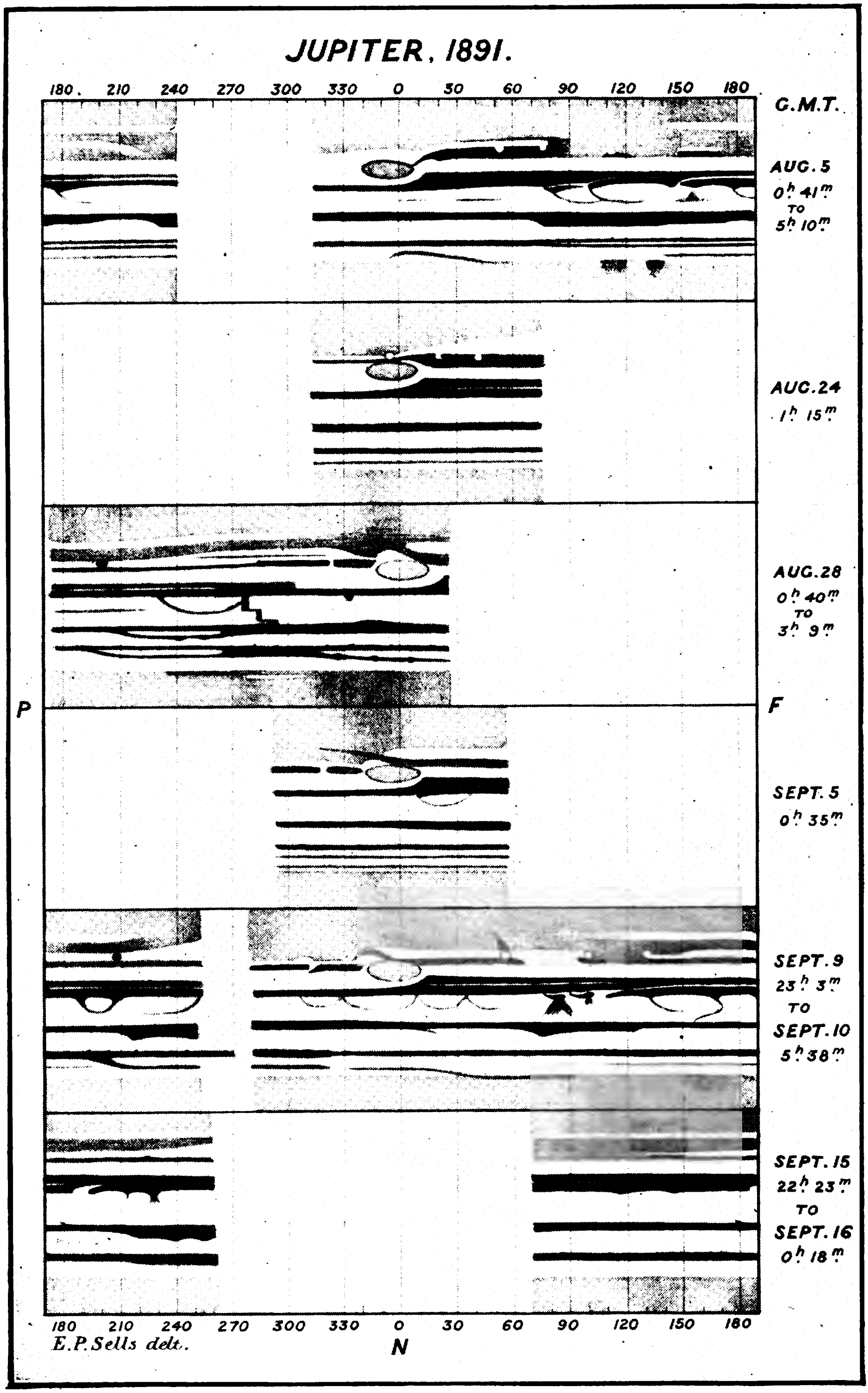
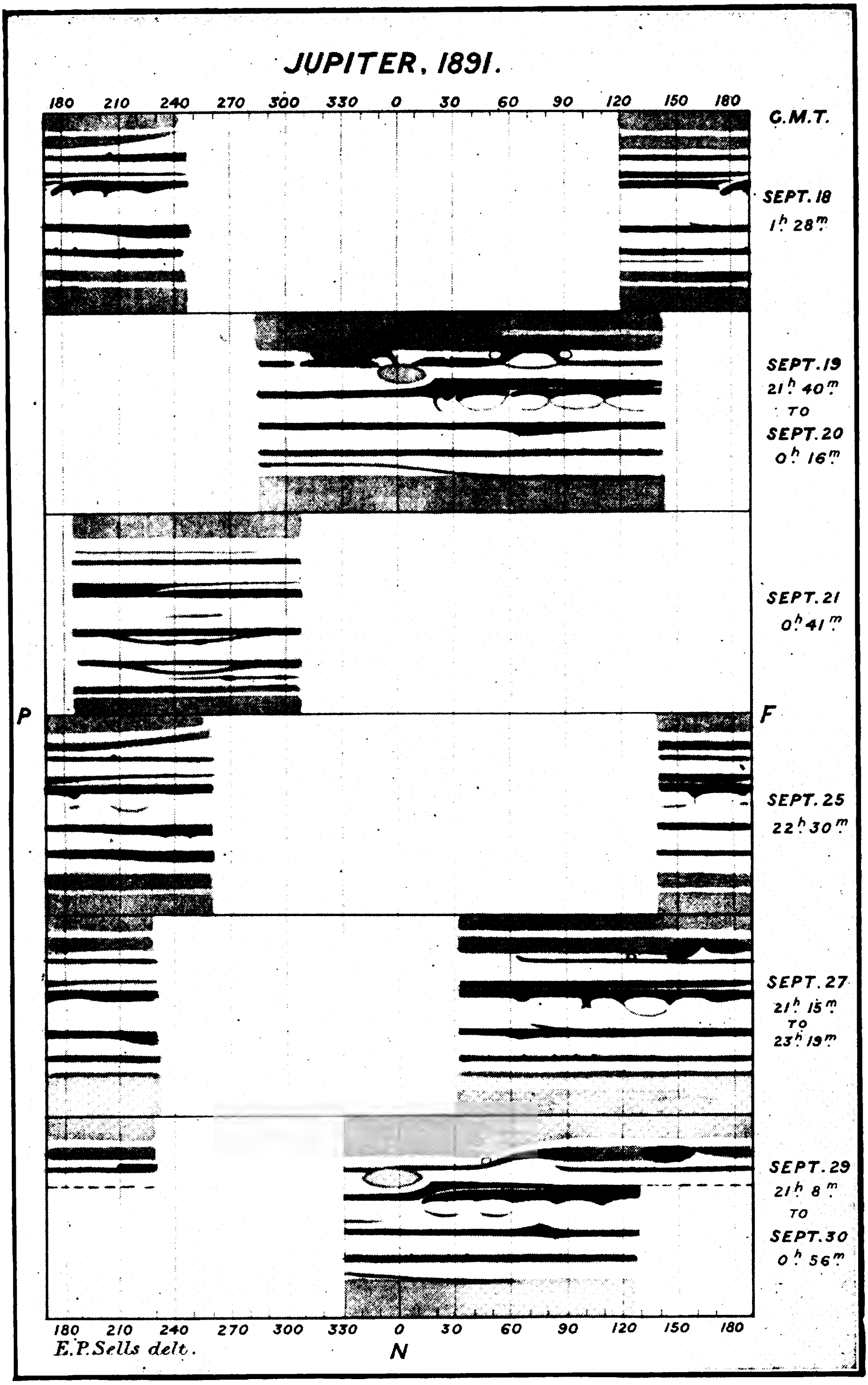


Plate XVIII.

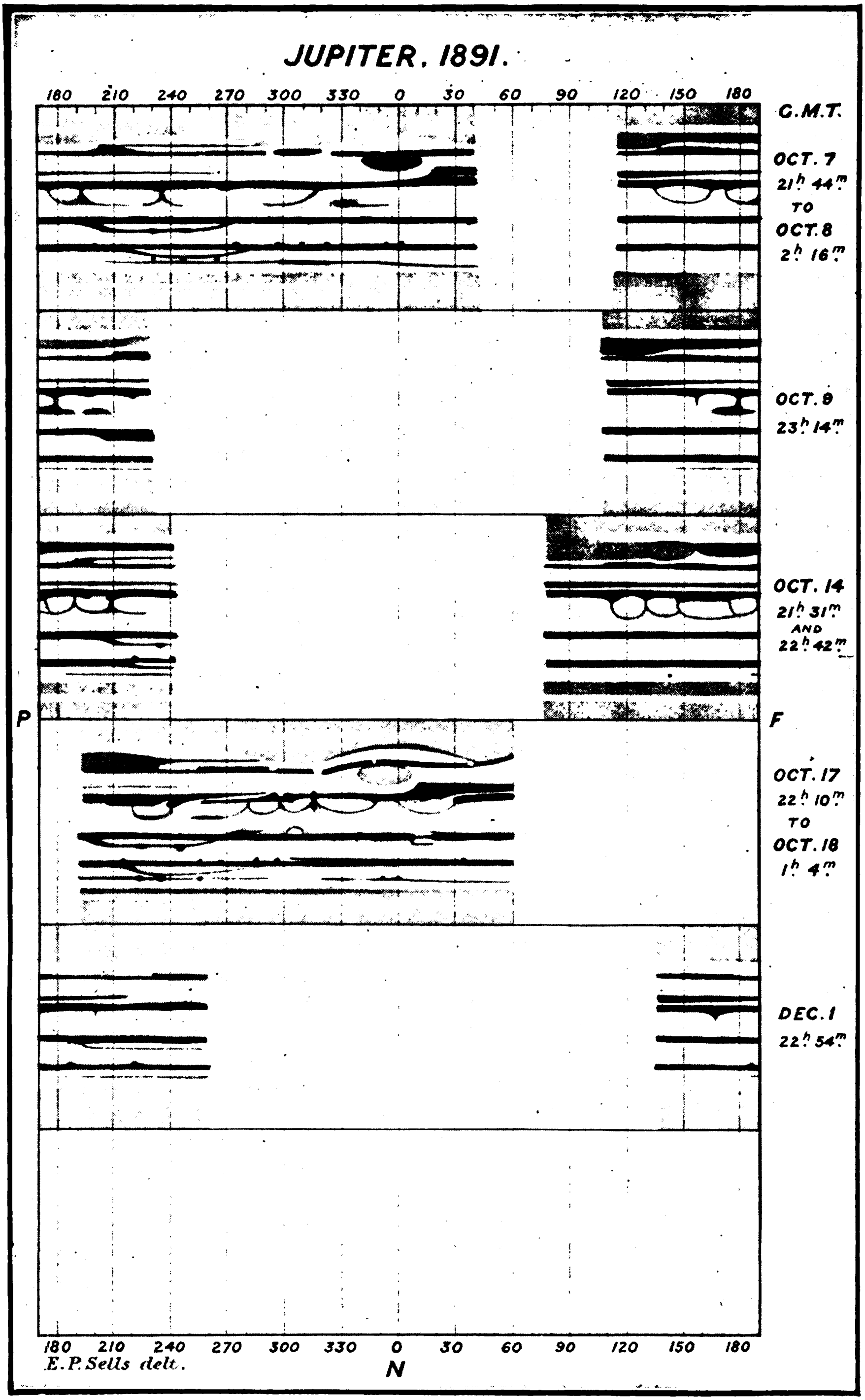
UNIV. OF MICH.



E. P. Sells delt.

Plate XIX.

UNIV. OF MICH.



JUPITER. 1891.

Plate XX.

UNIV. OF MICH.

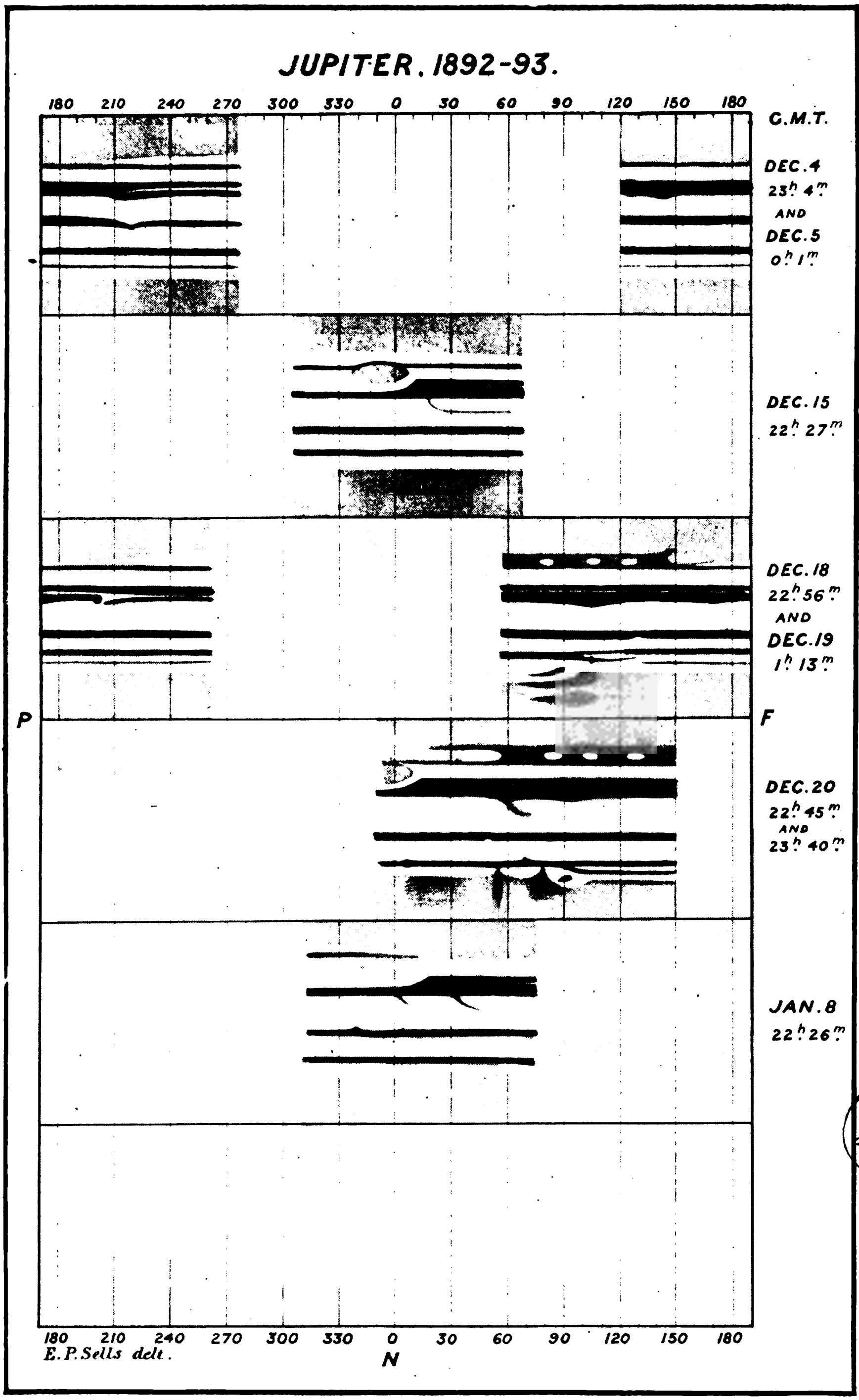

JUPITER, 1892-93.

Plate XXI.

UNIV. OF MICH.